



**United States Military Academy  
West Point, New York 10996**

**ANNUAL REPORT  
OF THE  
DEPARTMENT OF SYSTEMS ENGINEERING  
AND THE  
OPERATIONS RESEARCH CENTER  
FOR THE  
ACADEMIC YEAR 2004**

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**Lieutenant Colonel Michael J. Kwinn, Jr., Ph.D.**  
Associate Professor and Director, Operations Research Center of Excellence

**Colonel Michael L. McGinnis, Ph.D.**  
Professor and Head, Department of Systems Engineering

**SEPTEMBER 2004**

**Brigadier General Daniel J. Kaufman, Jr., Ph.D.**  
Dean of the Academic Board, United States Military Academy

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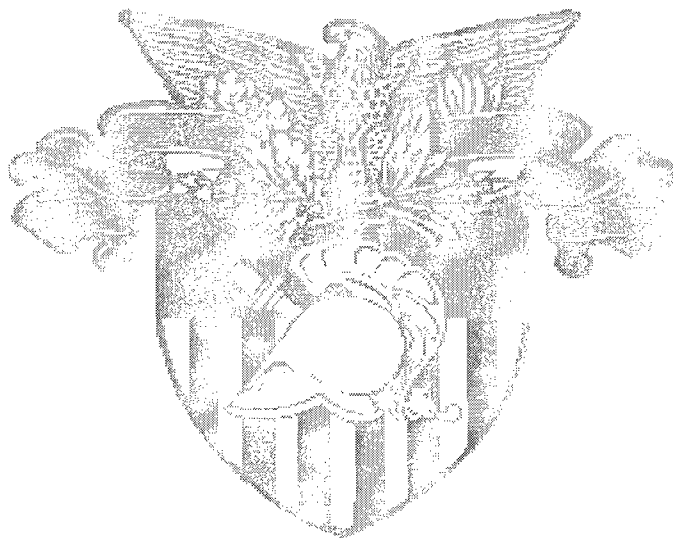
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## EXECUTIVE SUMMARY

The purpose of this document is to formally summarize and conclude the research program of the *U.S. Military Academy Department of Systems Engineering (DSE)* and the *Operations Research Center for Excellence (ORCEN)* for the Academic Year 03-04. The annual research report includes a statement of purpose for research which supports DSE and the ORCEN, a description of the two organizations, a list of the key personnel responsible for executing the plan, and an overview of the annual research cycle.

After this introduction, we present research summaries for applied research or problem-solving project. Each summary includes a problem statement and description, the methodology employed for project execution, a summary of results, a list of presentations and publications and a current status. Additional information is provided on the senior investigator, principal analyst the client organization, and points of contact.



## **PART I – THE DEPARTMENT OF SYSTEMS ENGINEERING RESEARCH PROGRAM**

*The purpose of the research program within the Department of Systems Engineering is to support cadet education and faculty development through the development, execution and presentation of relevant Army and Department of Defense research opportunities for significant clients.*

The Department of Systems Engineering research projects provide the faculty and cadets with the opportunity to investigate a wide spectrum of interdisciplinary, systemic issues and to apply many of the systems engineering, engineering management, and operations research concepts studied in the classroom to real-world problems of interest to the Army and the Department of Defense (DoD). These projects demonstrate for both cadets and faculty the relevance and importance of systems engineering in today's high-technology military.

The research program in the Department of Systems Engineering (DSE) directly addresses four specific Academy needs:

**1. Research enriches cadet education.** Cadets learn best when they are challenged and when they are interested. The introduction of current issues facing the military into their curriculum achieves both. Early in their education, cadets are taught by their instructors the application of techniques to real issues and problems – issues and problems they will face upon graduation. Through this, they gain an appreciation of the robustness of the discipline and a greater understanding of their profession. As they progress in their education, they begin to apply these techniques to heretofore unsolved issues and problems. This codifies their education on the techniques and instills an adaptive, problem-solving mentality in the cadets.

**2. Research enhances professional development opportunities for Army faculty.** It is important to develop and grow as a professional officer in each assignment. On the DSE faculty, officers conduct research on relevant projects to remain current in their operational branch or in the Functional Areas 49, 51, or 53. The research they conduct keeps them abreast of Army and DoD issues, at the forefront of their academic discipline and is returned to the classroom. They become better officers and leaders through the knowledge they gain and impart.

**3. Research maintains strong ties between the Academy and Army/DoD agencies.** The US Military Academy and DSE is a tremendous source of highly qualified analysts for the Army and DoD. Each faculty member holds an advanced degree in a technical discipline and has a deep understanding of the military and its issues. Research ensures that the Academy remains a

significant part of the Army and DoD and not just another source of commissioning for junior officers.

**4. Research provides for the integration of new technologies into the academic program.** As the pace of technological advances increases, the Academy's education program must not only keep pace but must lead to ensure our graduates and junior officers are prepared for their continued service to the Army. Research which applies the most advanced technology and techniques is critical to achieving this objective.

By being fully engaged in current Army and DoD issues, the Department of Systems Engineering and the Operations Research Center assures that systems engineering education at USMA and our faculty remain current and relevant. The military's return on its investment is meaningful career development experiences for officers, especially those in Functional Areas 49/51/53, an enhanced education program for the USMA cadets, and important investigation of vital Army and DoD problems at far less cost than would be required through civilian contracts.

The Department of Systems Engineering conducts research through its faculty and the Operations Research Center of Excellence (ORCEN). The ORCEN is the primary entry point for all research with the Department. The ORCEN Director is also the DSE Research Coordinator and oversees all aspects of the Department's research as well as personally directing research within the ORCEN.

## **PART II – THE OPERATIONS RESEARCH CENTER OF EXCELLENCE**

The purpose of the Operations Research Center of Excellence (ORCEN) is to provide a small, full-time analytical capability to both the Academy and the United States Army and the Department of Defense. The ORCEN was established in 1990 through a Memorandum of Agreement between the Department of Systems Engineering, the Department of Mathematics (DMath) and the Office of the Assistant Secretary of the Army (Financial Management and Comptroller). Its establishment was born of the burgeoning need for developing research opportunities to enrich DSE and DMath education.

Personnel authorizations in the ORCEN are established by a Table of Distribution and Allowances (TDA). Funding support for the Operations Research Center is established by a Memorandum of Agreement with the Office of the Assistant Secretary of the Army (Financial Management). The Operations Research Center is organized under the Office of the Dean as an Academy Center of Excellence. A permanent military Academy Professor provides oversight and supervision to the Center. In addition, the TDA authorizes one O5 analyst, three O4 analysts, and a GS5 secretary. By agreement between DSE and DMath, DSE provides three analysts, an Academy Professor as the Director and one permanent staff

member to serve as Executive Administrator and assistant to the Director and DMath provides one analyst.

The Operations Research Center is sponsored by the Assistant Secretary of the Army (Financial Management & Comptroller). Fully staffed and funded since Academic Year 1990-1991, the Operations Research Center has made significant contributions to cadet education, faculty development, and the Army at large. The following is a list of key personnel from the Operations Research Center for the Academic Year 2003.

TITLE & ORGANIZATION	NAME	PHONE (DSN)	EMAIL
Associate Professor and Acting Head Department of Systems Engineering	COL William K. Klimack, Ph.D.	688-2701	William.Klimack@usma.edu
Professor and Head Department of Mathematical Sciences	COL Gary Krahn, Ph.D.	688-5285	Gary.Krahn@usma.edu
Director, ORCEN & Associate Professor	LTC Michael J. Kwinn, Jr., Ph.D.	688-5529	Michael.Kwinn@usma.edu
Executive Officer & Research Coordinator	Ms. Linda Ann J. Albronda	688-5897	Linda.Albronda@usma.edu
Deputy Director, ORCEN & Associate Professor	Lt. Col. Edward A. Pohl, Ph.D.	688-5168	Edward.Pohl@usma.edu
D/MS Analyst & Instructor	MAJ Mark Gorak, M.S.	688-5539	Mark.Gorak@usma.edu
D/SE Analyst & Assistant Professor	MAJ John Brence, Ph.D.	688-3573	John.Brence@usma.edu
D/SE Analyst & Instructor	CPT Eric Tollefson, M.S.	688-5661	Eric.Tollefson@usma.edu

Table 1: Key ORCEN Personnel

### PART III – FACULTY RESEARCH

The Department of Systems Engineering encourages its faculty to conduct research of value for the Army and the Department of Defense during their tenure at the United States Military Academy. This specifically includes the rotating junior faculty to support their professional development.

During Academic Year 04, the Department of Systems Engineering had 15 faculty members holding a Ph.D and 21 individuals on the faculty holding a Masters Degree. Each holds their advanced degrees in disciplines which support research in systems engineering, engineering management and/or operations research. This is a tremendous research potential for significant clients within the Army and DoD.

All research in the Department of Systems Engineering is overseen by a Senior Investigator (SI) to ensure quality and completeness for the client. These Senior Investigators all hold a Ph.D in a qualified discipline for the research project presented. Most research projects have an associated junior analyst assigned to them. This contributes to the development of the junior analyst as a researcher, the Senior Investigator as a research lead and provides the client with the best research available by the Department.

NAME	EDUCATION & DEGREE	PHONE (DSN)	EMAIL
COL William K. Klimack	PhD – Air Force Institute of Technology – 2002 MS – Johns Hopkins University – 1999 MMAS – US Army CGSC – 1991 BS – Lehigh University - 1979	688-4625	William.Klimack@usma.edu
COL Margaret Belknap	MS - Army War College - 2001 PhD – University of Pennsylvania – 2000 MSE - University of Michigan – 1989 BS - USMA – 1981 MA - Naval War College - 1996	688-5534	Margaret.Belknap@usma.edu
Dr Gregory Parnell	PhD – Stanford University – 1985 MS – University of Southern California – 1980 ME – University of Florida – 1974 BS – State University of NY (Buffalo) - 1970	688-4374	Gregory.Parnell@usma.edu
Dr. Patrick J. Driscoll	PhD – Virginia Tech – 1995 MS – Stanford University – 1989 BS – USMA – 1979	688-6587	Patrick.Driscoll@usma.edu
Dr. Bobbie Foote	PhD – University of Oklahoma – 1967 MS – University of Oklahoma – 1963 BS – University of Oklahoma - 1961	688-4893	Bobbie.Foote@usma.edu
LTC Willie J. McFadden, III	PhD – Old Dominion University – 2000 MS – Naval Postgraduate School – 1993 BS – USMA – 1983	688-5941	Willie.McFadden@usma.edu
LTC Michael J. Kwinn, Jr.	PhD – University of Texas (Austin) – 2000 MS – University of Arizona – 1994 BS – USMA – 1984	688-5529	Michael.Kwinn@usma.edu
Dr/ Roger C. Burk	PhD – University of North Carolina – 1993 MS – Air Force Institute of Technology – 1985 BA – St. John's College – 1974	688-4754	Roger.Burk@usma.edu
LTC Timothy E. Trainor	PhD – North Carolina State University – 2001 MBA – Duke University – 1992 BS – USMA – 1983	688-4625	Timothy.Trainor@usma.edu
LTC William Bland	PhD – University of Virginia – 2003 MS – Florida Institute of Technology – 1995 BS – USMA – 1983	688-5181	William.Bland@usma.edu
LTC Rocky Gay	PhD – Texas A&M – 2002 MS – Texas A&M – 1993 BS – USMA – 1982	688-5578	Rocky.Gay@usma.edu
Dr. Paul West	PhD – Stevens Institute of Technology – 2003 MTM – Stevens Institute of Technology – 2000 MBA – Long Island University – 1993 BS – State University of NY (Albany) – 1983	688-5871	Paul.West@usma.edu
LTC Robert Powell	PhD – Stevens Institute of Technology – 2002 MMAS – US Army CGSC – 1999 MS – George Mason University – 1995 BS – Texas A&M University - 1984	688-4311	Robert.Powell@usma.edu
MAJ John Brence	PhD – University of Virginia – 2004 MS – University of Virginia – 2001 BS – USMA – 1991	688-3573	John.Brence@usma.edu

Table 2: DSE Senior Investigator

NAME	EDUCATION & DEGREE	PHONE (DSN)	EMAIL
LTC Pamela Hoyt	MS – George Mason University – 1996 MA – Naval War College – 1990 BA – University of Vermont (Burlington) – 1984	688-2788	Pamela.Hoyt@usma.edu
LTC Brigitte Kwinn	MS – University of Arizona – 1994 BS – USMA – 1984	688-6493	Brigitte.Kwinn@usma.edu
LTC Veronica Zsido	MS – University of Louisville 1997 BS – USMA – 1987	688-5206	Veronica.Zsido@usma.edu
MAJ James Corrigan	MS – Texas A&M – 2001 BS – USMA – 1992	688-4753	James.Corrigan@usma.edu
MAJ John Cushing	MS – University of Virginia – 2003 BS – USMA – 1993	688-4399	John.Cushing@usma.edu
MAJ Patrick Downes	MS – University of Virginia – 2002 BS – USMA – 1993	688-3114	Patrick.Downes@usma.edu
MAJ Mark Gorak	MS – Naval Postgraduate School – 2001 BS – Marquette University – 1991	688-5539	Mark.Gorak@usma.edu
MAJ John Harris	MS – University of Virginia – 2002 BS – USMA – 1993	688-5536	John.Harris@usma.edu
MAJ Steven Henderson	MS – University of Arizona – 203 BS – USMA – 1994	688-3573	Steven.Henderson@usma.edu
MAJ Robert Keeter	MS – University of Virginia – 2003 BS – USMA – 1993	688-4857	Robb.Keeter@usma.edu
MAJ Gregory Lamm	MS – University of Virginia – 2001 MS – Penn State University – 1990	688-4792	Gregory.Lamm@usma.edu
MAJ Linda Lamm	MS – University of Virginia – 2001 BS – USMA – 1992	688-5661	Linda.Lamm@usma.edu
MAJ Robert Lenz	MS – Ohio State University – 2003 BS – USMA – 1993	688-4756	Robert.Lenze@usma.edu
MAJ Grant Martin	MS – Georgia Institute of Technology – 2003 BS – USMA – 1994	688-5661	Grant.Martin@usma.edu
MAJ Thomas Rippert	MS – University of Texas (Austin) – 2003 BS – USMA – 1993	688-2510	Thomas.Rippert@usma.edu
MAJ Russell Schott	MS – Georgia Institute of Technology – 2001 BS – USMA – 1991	688-4752	Russell.Schott@usma.edu
MAJ Curtis Tait	MS – University of Virginia – 2004 BS – USMA – 1994	688-5537	Curtis.Tait@usma.edu
MAJ Holly West	MBA – University of Kentucky – 2001 BS – USMA – 1991	688- 2510	Holly.West@usma.edu
CPT Gregory Boylan	MS – Georgia Institute of Technology – 2003 BS – USMA – 1994	688-4753	Gregory.Boylan@usma.edu
CPT Eric Tollefson	MS – Georgia Institute of Technology – 2002 BS – USMA – 1994	688-5663	Eric.Tollefson@usma.edu
CPT Jason Wolter	MEM – Northwestern University – 2004 BS – USMA – 1994	688-4888	Jason.Wolter@usma.edu
Ms. Robin Burk	MBA – University of North Carolina – 1992 BA – St. John's College – 1973	688-2746	Robin.Burk@usma.edu

Table 3: DSE Analysts



## PART IV – THE DEPARTMENT RESEARCH CYCLE

Regardless of the research thrust, the research source or the client, each research proposal must be approved through the DSE Research Council and the Department Head. The ORCEN Director, in the role of the Department Research Coordinator, collects potential project proposals from Senior Investigators and brings the research opportunity to the Department Research Council which is headed by the DSE Department Head. This development of research opportunities is normally conducted in the summer, when the academic load wanes for our senior investigators.

At the beginning of the academic year in August, the ORCEN the research council convenes to review each research proposal for support and for the identification of required resources. The ultimate authority for approving the allocation of resources (which includes funding, lab time and analyst time) is the Head, Department of Systems Engineering. Once approved, the researchers can execute the research plan.

The Research Cycle for an Academic Year for the Department of Systems Engineering is illustrated in Figure 3. This is a depiction of the objective annual research cycle, which involves several processes in executing the research plan. Among them is the development of research opportunities, the approval timelines and the completion times for each project. Research opportunities can be developed during the academic year, or off-cycle. These projects are tentatively approved through the Department Research Coordinator and the Department Head. They will ultimately be required to be approved by the Research Council in their January, mid-year meeting.

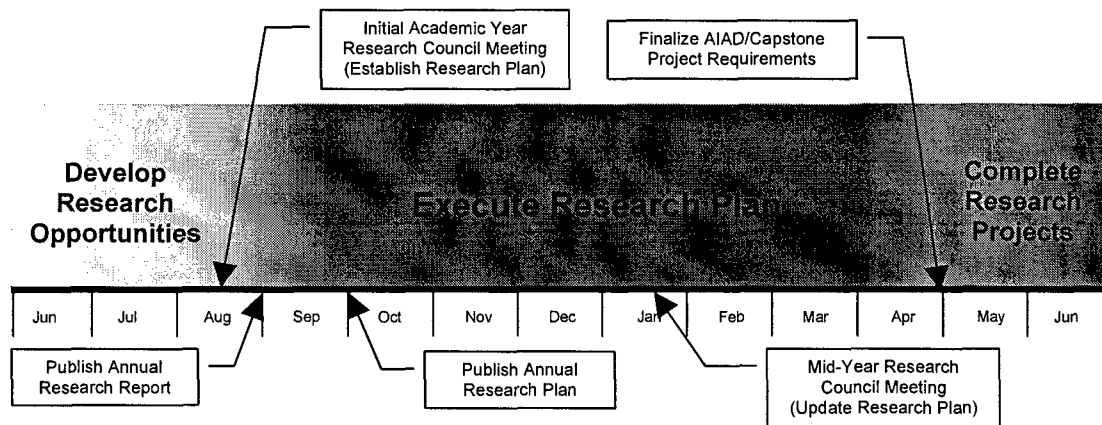


Figure 3: DSE/ORCEN Annual Research Cycle

As can be assumed based on the cycle above and the research approval process described above, the Department and the Operations Research Center does not solicit nor conduct many "short turnaround" research projects though there are some that they conduct. The reason for this goes back to the initial objectives of the Department's research program, which is to support the development of the junior analysts. In the ORCEN, the analysts rotate each year. To ensure that their time is used and they develop as a researcher, most projects are year-long works.

## PART V – Principal Research Activities – AY04

### *Modeling Corrosion using Non-destructive Test Data: An Application of Robust Measures to Random Forest Regression*

**DSE Project No: DSE-R-0401**

**Client Organization:** Department of Systems and Information Engineering,  
University of Virginia & USAF Research Laboratories,  
Wright- Patterson AFB, OH

**Principal Analyst:** MAJ John Brence, Ph.D  
**Senior Investigator:** Prof. Patrick J. Driscoll, Ph.D

#### **Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Donald E. Brown, Ph.D (PhD Advisor)	Department Chair Department of Systems and Information Engineering University of Virginia	804-982-2074	brown@vrginia.edu
Ms. Deborah Peeler (Potential Client)	USAF Research Laboratories Wright- Patterson AFB, OH		Deborah.Peeler@wpafb.af.mil

#### **Problem Description:** *(Dissertation Research for PhD in Systems Engineering)*

Quicker and more effective methods of corrosion prediction and classification can assist ensuring a safe and operational transportation system for both civilian and military sectors. These methods are especially critical as transportation providers are making corrosion (maintenance) decisions on aging aircraft in a constrained budget environment. These budget constraints make it imperative to identify corrosion and to correctly determine the appropriate time to replace corroded parts. If a corroded part is replaced too soon, the result is wasted resources. However, if the part is not replaced soon enough, it could cause a catastrophic accident. Developing models that limit the possibility of a costly accident while optimizing resource utilization would enable transportation providers to efficiently focus their maintenance efforts. While our concern is primarily with aircraft, the results are useful to other transportation providers as well.

#### **Proposed Work:**

- Research and Evaluate several modeling methods

- Try to improve upon best performing algorithm using theoretical hypotheses and testing
- Create a useful program that either enhances or replaces current methods of corrosion identification

### **Results Summary:**

Analysis of robust measures in Random Forest Regression (RFR) is an extensive empirical analysis on a new method, Robust Random Forest Regression (RRFR). The application and analysis of this tree-based method has yet to be addressed and may provide additional insight in modeling complex data. An important engineering application of this study that spans both science and safety is the complexity challenge to model corrosion. There is a need for better predictive capabilities for both safety and scientific related datasets which inherently have noisy data and, many times, are embedded with outliers.

This study builds on previous research that explores the discovery and comparison of empirical models to predict corrosion damage from non-destructive test (NDT) data. One goal for this research is to improve upon the current methodology of corrosion prediction and diagnostics from non-destructive tests (specifically eddy currents). We met this goal by improving our prediction relative error by 18.8%.

Our approach is based on the RFR with two major differences ~ the introduction of robust prediction and error statistic. The current methodology utilizes the node mean for prediction and mean squared error (MSE) to derive the in-node and overall error. Herein, we introduce and assess the use of a median (and other robust measures) for prediction and mean absolute deviation (MAD) to derive the in-node and overall error. Extensive research has shown that the median is a better prediction of the centrality of the distribution in the presence of large or unbounded outliers because the median inherently ignores these outliers basing its prediction on the ordered, central value(s) of the data.

Our research hypothesis is that robust methods should significantly improve the predictive performance of random forest methods for nonparametric regression when the data contains unbounded outliers and displays the heteroscedastic property. We have shown that RRFR performs well under extreme conditions; with datasets that include unbounded outliers or heteroscedastic conditions. This hypothesis was tested using corrosion data and other datasets. Comparative performance among models was based on both the mean-squared-error (MSE) and mean-absolute-deviation (MAD) statistics.

The NDT data were derived from eddy current (EC) scans of the United States Air Force's (USAF) KC-135 aircraft. While we might suspect a link between NDT results and corrosion, up until now this link has not been formally established. Instead, the NDT data have been converted into false color images that are analyzed visually by maintenance operators. Previous models that we introduced suggest that by applying appropriate data mining techniques we can

more effectively handle noisy data through more sophisticated models rather than simpler ones. Moreover, while a variety of modeling techniques can predict corrosion with reasonable accuracy, regression trees are particularly effective in modeling the complex relationships between the eddy current measurements and the actual amount of corrosion.

**Requirements and Milestones:**

- Create algorithm using programming language (Fall 03) *Complete*
- Conduct Theoretical tests on new algorithm and validate model (Fall 03) *Complete*
- Write-up findings and defend dissertation (Spring 04) *Complete*

**Project Deliverables and Due Date:**

- Dissertation Defense (Spring 04) *Complete*
- Dissertation Write-up (Spring 04) *Complete*

**Presentations and Publications:**

- Brence, John. Complexity Challenges in Modeling Corrosion: Applying Robust Measures to Random Forests for Regression, Dissertation Proposal and Presentation. 11 November 2002.
- Brence, John R., *Analysis of Robust Measures for Random Forest Regression*, Doctoral Dissertation, University of Virginia, May 2004.
- Brence, John R PhD, Driscoll, Patrick J. PhD, Kwinn, Michael Jr. PhD, *Modeling Corrosion using Non-destructive Test Data: An Application of Robust Measures to Random Forest Regression*, Operations Research Center of Excellence, Technical Report DSE-TR-04-01, May 2004.

**Personnel Briefed:**

- Dr. Patrick Driscoll (DSE, USMA, Senior Investigator)
- LTC Michael J. Kwinn Jr., PhD (ORCEN Director)
- Dr. Donald Brown (DSIE, UVA. Advisor)
- Dr. William Scherer (DSIE, UVA, Chair)
- Dr. Michael DeVore (DSIE, UVA, Committee Member)
- Dr. Peter Beling (DSIE, UVA, Committee Member)

**Status:** Complete.

## ***US Army Recruiter Allocation Model***

**DSE Project No: DSE-R-0403**

**Client Organization:** US Army Accessions Command, US Army Recruiting  
Command, Fort Knox, KY

**Principal Analyst:** MAJ John Brence, Ph.D  
**Senior Investigator:** LTC Michael J. Kwinn, Jr., Ph.D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
LTC Stephen McCarty	Chief, Research Integration and Support Center for Accessions Research, USAA	502-626-0322	stephen.mccarty@usaac.army.mil
MAJ Vincent O'Rourke	HQ USAREC Attn: RCPAE (MAJ O'Rourke) Bldg. 1307 Fort Knox, KY 40121	502-626-1872	Vincent.orourke@usarec.army.mil

### **Problem Description:**

The U.S. Army is revisiting their allocation of recruiting stations model in order to more effectively and efficiently recruit new soldiers. USAREC/USAAC wants to centrally locate their recruiting facilities in order to maintain coverage across the nation and improve recruiting efforts.

Development of a useful recruiting model requires an in-depth investigation of previous models and the recruiting processes of today. An objective study of the quantitative and qualitative aspects of recruiting is necessary to meet the future needs of the Army, in light of strong possibilities of recruiting resource reduction and increasing mission requirements. Our research will develop a model with an eye towards recruiting process improvement. Our methodology will build on both the new and old schools of recruiting by conducting stakeholder interviews that will lead us to a model that is an efficient starting point for the Recruiter Mission Allocation (RMA) process, ensures user buy-in, and seeks to fill-in process pitfalls along the way.

### **Proposed Work:**

Allocating Army recruiters to meet mission requirements is a very sensitive and important issue. Each level of command in USAREC has a key stake in the outcome of this study. This study will determine the amount of recruiters each command will receive. Ideally, each command would like to be heavily resourced with recruiters and lightly burdened with recruitment mission due to the considerable emphasis placed on recruiting mission success. The impact of

moving one recruiter or allocating one more recruit to the mission could result in a command failing its mission which requires a detailed explanation of the reasons for failure directly to the higher headquarters.

### **Results Summary:**

Our focus in developing a recruiter allocation model is to keenly study the required inputs to develop an efficient, feasible model that closely describes what is required for USAREC to meet or surpass their recruiting mission. We are very sensitive to the needs of the people involved in this process and feel that the model needs "user buy-in" to be effective. The current and previous models were never validated with any confidence, even though USAREC still made mission. Most of the success of USAREC lies in its leadership and hard work from all individuals involved and not necessarily the current model. We would like to lessen the burden of the RMA process and set-up each command level for success by creating an effective model and recommending several process improvements.

The difficulty in the derivation of this model is deciding how to succinctly build it so all parties understand how and why it works, while taking into account the accuracy of the model. The model should be useful enough that only slight modifications are made to the recommended recruiter resourcing. The benefits of such a model are that it would lessen the duration of the RMA process and decrease the workload of the leadership. Ideally, as the model continues to evolve and the leadership becomes more confident in the recruiter allocation model, the RMA process will focus only the model result with insignificant feedback from the recruiting brigades. We hope to succeed in creating such a model, especially now, when our country needs a strong and responsive military.

We chose to use a more sophisticated model than previous models for two reasons. First, the model needs to provide any into recruiting efficiency. Our solution to this issue is that recruiting efficiency may be attained through Data Envelopment Analysis (DEA). Second, a linear relationship will do a poor job in emulating the true recruiting markets. For example, a linear relationship between GMA contracts and the number of recruiters is sub-optimal since at some point we will saturate the market with recruiters; in which more is oftentimes not better. The same argument may be made for advertising dollars.

To more closely emulate the true recruiting markets, we use a logarithmic transform of a Cobb-Douglas production function which from economic theory is said to be *technically efficient*. Previous research in this area has also utilized this approach. However, a Cobb-Douglas function is technically efficient for private sectors, assuming that inefficiency leads to a disbanded company. Since we are modeling the public sector, where an agency may or may not be successful and still be in business, we need to integrate another means to adjust for efficient performers. We use DEA to make this adjustment.

Our decision to study the process of recruiting from the bottom-up is heavily based on our Stakeholder Analysis. Initially, this phase of our research was not in the scope of the study; however, it is very clear that there are many qualitative

issues that plague USAREC and Army recruiting. There was a significant concern about the bureaucracy of choosing recruiting station location and how leases kept recruiters in a potentially stagnant market. Other comments indicated that the leadership was inexperienced with recruiting, since most individuals only spend a three-year tour on task. Lastly, many stakeholders explained that there was a lack of effort or an “overwhelming” effect on newbie recruiters. Many of these comments lead us to believe that a decent mathematical model would only solve a portion of the problem and more analysis into the process was necessary.

The most significant research effort we accomplished was to gather a panel of experts to discuss the future of Army recruiting. Our panel is comprised of many former personnel that served in USAREC and/or were tasked to conduct similar studies. Many of these individuals have gone on to be leaders of industry in related fields such as human resources and marketing. We received expert advice and feedback on what research was done in the past and cutting-edge methods used today by industry to recruit and market. In this analysis we evaluated potential areas for recruiting process improvement and came up with several suggestions for USAREC.

#### **Requirements and Milestones:**

- Initial Briefing on Statement of Work and Study Guidelines (SEP 03) *Complete*
- Stakeholder Interviews, 9 total (OCT 03 – JAN 04) *Complete*
- Recruiter Management Workshop (MAR 04) *Complete*
- In-progress Review Brief to LTC McCarty & MAJ Vincent O’Rourke (May 04) *Complete*

#### **Project Deliverables and Due Date:**

- Final Research Brief (July 04) *Complete*
- Tech Report (July 04) *Complete*

#### **Presentations and Publications:**

- Brence, John R., Kwinn, Michael J. Jr. Ph.D., Thomas, David A. Ph.D., *Modeling for US Army Recruiter Allocation*, Proceedings of The Institute of Industrial Engineers Annual Conference, Houston, TX, 15-19 MAY 2004.
- Brence, John R. Ph.D., Kwinn, Michael J. Jr. Ph.D., *United States Army Recruiter Allocation Model*, Operations Research Center of Excellence, Technical Report DSE-TR-04-03, July 2004.



- Brence, John R. Ph.D., *Recruiter Allocation Model Research Applicability to Classroom Instruction*, Information Paper for D/SE and D/MATH. June 2004.
- Brence, John R., Kwinn, Michael J. Jr., Ph.D., Wolter, Jason A., *A White Paper Summary: Recruiter Management Workshop*, Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 30 March 2004.
- Brence, John R. Ph.D., Kwinn, Michael J. Jr. Ph.D., Thomas, David A. Ph.D., *Qualitative and Quantitative Analysis for U.S. Army Recruiting Input Allocation*, 72<sup>nd</sup> Military Operations Research Society Symposium, Naval Postgraduate School, Monterey, California 22-24 June 2004. *Selected as Best in Working Group 20 and Finalist for 2004 Barchi Prize.*

**Personnel Briefed:**

- LTC Stephen McCarty (CAR, USAAC)
- LTC (Ret) Rick Ayer (USAREC G2)
- MAJ John Shupenus (USAREC G2)
- MAJ Vincent O'Rourke (USAREC G2)
- Ms. Rae Disney (USAREC)

**Status:** Complete.

## ***Soldier Tactical Mission System (STMS) Effectiveness***

**DSE Project No: DSE-R-0405**

**Client Organization:** Program Executive Office Soldier, Fort Belvoir, VA

**Principal Analysts:** CPT Eric Tollefson, M.S.

**Senior Investigators:** LTC Michael J. Kwinn, Jr., Ph.D., Dr. Roger Burk, Ph.D.

### **Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Charlie Tamez (Systems Integration)	PEO Soldier 5901 Putnam Road, Bldg 328 Fort Belvoir, VA 22060-5422	703-704-4073 DSN 654-4073	charlie.tamez@peosoldier.army.mil

### **Problem Statement:**

**Background** - In order to remain the premier land fighting force in the world, the US Army soldier must be outfitted with the most technologically-advanced equipment possible. However, such equipment is expensive to design, test, evaluate, and implement. Therefore, proposals for such equipment should include a quantitative evaluation of the expected benefit to mission accomplishment that system or component provides the soldier and his unit.

Simulation models are a potential tool for such evaluations. However, the commonly-used simulation models for analytical studies, constructive simulation models, are currently not capable of modeling the advanced soldier interaction and situational awareness that the proposed soldier tactical mission systems (STMS) facilitate.

**Problem Statement** - Program managers need a quantitative methodology to evaluate the benefit to mission effectiveness provided by the STMS as a whole, and by individual or groups of components.

**Scope of Work & Methodology:** The work for this project over the last year consisted primarily of defining the problem, including detailed functional and requirements analyses. Additionally, we began to build expertise with the relevant agent-based models and coordinate with other agencies doing similar work. We are now beginning to focus on the actual application of agent-based models for the evaluation of STMS effectiveness.

## **Results Summary:**

**Needs Analysis** - This portion of the work was completed in conjunction with project DSE-R-0421, Simulation Roadmap for PEO Soldier Programs, since both projects stemmed from the same need. We determined that the simulation model requirements flow from two primary needs: the need for a tool to compare candidate soldier tactical mission systems (STMS) and the need for realism. An STMS is any system, or system of systems, worn or carried by the Infantry soldier on the battlefield. To be useful, a simulation model must produce valid outcomes based upon the inputs. The outcomes normally desired are called measures of effectiveness (MoEs). MoEs used to evaluate an STMS would assess its mission capability and survivability (lethality, mobility, protection, communications, and situational awareness) and its trustworthiness (reliability, availability, maintainability, sustainability, and usability). An example of an MoE used to evaluate lethality is *total number of enemy kills*. Each MoE may depend upon a large number of measures of performance (MoPs). MoPs are lower-level measures that quantify the performance of a particular piece of equipment or human task. Using the lethality example, the total number of enemy kills may be a function of the following MoPs: weapon rate of fire, accuracy, reliability, human aiming error, target location error, etc. Thus, the agent-based simulation must provide a required MoE output while allowing the user to alter some of the MoP inputs representing the unique characteristics of the STMS under study.

**Requirements Methodology** - To ensure that we captured the simulation requirements, we uniquely applied a combination of functional and input-output analyses to the soldier on the battlefield. We constructed a comprehensive hierarchy of the functions a soldier executes in the performance of his mission. For each of those functions, we identified the inputs transformed by the function and the outputs produced. We also captured the attributes of the soldier that affect how that soldier transforms inputs to outputs.

**Resulting Requirements** - Our methodology led to a detailed document identifying over 130 soldier functions that need to be modeled, with inputs, outputs, and attributes. We can now, therefore, determine which of those functions can be modeled using agent-based models. For instance, such models are uniquely capable of demonstrating the effects of attributes like courage, fear, aggressiveness, etc, which is a capability that many larger, physics-based models lack.

**Building Agent-based Modeling Proficiency** - With PEO Soldier's needs and requirements clearly identified, we began to build initial proficiency in relevant agent-based models. We had a subject matter expert come to our department in order to install the relevant agent-based models on department computers and to train department personnel on the use of that software.

**Coordination with Other Agencies** - We have also made initial coordination with the TRADOC Analysis Center in Monterey, CA (TRAC-MTRY) in order to capitalize on potential synergies between our organizations regarding agent-based modeling research.

**Conclusions** - We are now at a point in our research where we can begin to apply agent-based models to a subset of the overall simulation requirements that we developed. Ideally, we will be able to develop a methodology for the use of such models to evaluate particular aspects of potential STMS.

***Lead-the-Fleet: Transitioning the Army from a time based maintenance system to a usage based maintenance system***

**DSE Project No: DSE-R-0406**

**Client Organization:** PM LTF, Aviation and Missile Research, Development and Engineering Center (AMRDEC), U.S. Army Research, Development and Engineering Command (RDECOM), Redstone Arsenal, AL 35898. APM LTF, U.S. Army Aviation Technical Test Center (ATTC), Developmental Test Command (DTC), Fort Rucker, AL 36362

**Principal Analyst:** MAJ Mark Gorak, M.S.  
**Senior Investigator:** LTC Michael J. Kwinn, Jr., Ph. D.

**Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Mike McFalls PM LTF Army Test and Evaluation	AMRDEC, US Army RDECOM AMSAM-RD, Bldg 8716 Redstone Arsenal, AL 35898	DSN 746-3462 256-876-3462 Cell: 256-714-8362	Michael.McFalls@rdc.redstone.army.mil
MAJ Jong-Hyuk Lee APM LTF Avn Technical Test Center	U.S. Army ATTC, Flight Test Directorate Cairns AAF, Bldg 30133 Fort Rucker, AL 36362	DSN 558-8164 (334) 255-8164 Cell: (334) 467-5180	Jong.Lee@attc.army.mil
Bill Braddy Deputy PM Cobro Corporation	Huntsville Engineering Center 4950 Corporate Drive, Suite 125 Huntsville, AL 35805	(256) 430-1610 Ext 124 Fax: (256) 430-1611 Cell: (256) 509-5896	Braddy@Cobrosv.com

**Problem Description:**

U.S. Army helicopters are extremely complex machines designed to perform within broad operational usage envelopes. The operational usage envelopes are defined by discrete flight regimes that consist of combinations of aircraft configurations and flight maneuvers. Each regime can occur in combination with varying values of engine torque, engine speed, and rotor speed. Army helicopter system and component scheduled maintenance, overhaul, and retirement actions typically are based on calendar times and flight hours. These times are based on a —composite worst- case“(CWC) presumption of helicopter regime usage. CWC usage is derived for each U.S. Army helicopter model to capture the most severe

usage that helicopter models can ever be expected to experience. Knowledge of actual operational usage can be used to identify unsafe usage, refine scheduled maintenance actions, and predict unscheduled maintenance requirements. The purpose of the Lead the Fleet (LTF) program is to gain better insight into the accumulated damage that each U.S. Army helicopter could experience during actual operational usage and to use that knowledge to evaluate overhaul and retirement times, increase safety and operational readiness, and reduce costs.

The LTF approach is to increase the flight-hour rate and usage intensity of selected Army helicopters to identify safety, reliability, availability, and maintainability (RAM), and logistics issues before they occur during normal operational usage. In this manner, system and component deficiencies can be identified, addressed, and corrected prior to fleet-wide requirements for costly restorations, modifications, or retrofits. LTF provides the early opportunity to capture aircraft usage information that can be correlated with discrepancies and failures to establish meaningful usage-related safety and logistical trends. As a minimum, LTF will monitor and record the amount of time each airframe and each dynamic component is exposed to damaging flight regimes and evaluate the resultant accumulated damage. The basic parameters required to identify these flight regimes include gross weight, airspeed, altitude, roll angle, vertical acceleration, and ground-air-ground cycles.

#### **Proposed Work:**

The Operations Research Center of Excellence, USMA, consider this the first year of a multi-year research effort with PM-LTF. In this first year, the ORCEN will provide a full-time analyst and additional faculty members to provide statistical and analytical research to support the current LTF efforts. Potentially, the ORCEN will also involve cadets in this year's research effort. Cadet involvement is beneficial in that it exposes cadets to real Army challenges and enables them to make an impact on the future of the Army which they will serve. As future leaders this experience also gives them an insight into Army Aviation and enables them to see how Lead-the-Fleet will affect future aviation operations. This year, cadets will be offered Academic Individual Advanced Development (AIAD) opportunities to work as summer interns with LTF operations both in the field and with Westar headquarters. Analysts will conduct a thorough review of existing documentation and interviews of appropriate personnel to fully understand the current LTF mission. PM LTF will provide data collection, data dissemination, clarification and comments throughout the course of this effort.

#### **Results Summary:**

The results of the ORCEN analysis are summarized in the culmination of the LTF business plan. The ORCEN facilitated the beginnings of the LTF business plan and developed the LTF program plan which was used as a basis for the final LTF Business plan. The ORCEN facilitated several working group meetings with all members of the LTF team to gain insight and publish the LTF program mission,

goals, objectives and measures of effectiveness which lead to the restructuring of the program.

**Project Deliverables and Due Date:**

- Program Orientation: 12-14 Nov 03: Background data, research focus, needs analysis

***Interim IPRs:***

- 01DEC03: LTF Briefing to GEN Kern, Alexandria, VA
- 26FEB04: Interim briefing of results. Final coordination of deliverables
- 25MAY04: Final out brief

**Presentations and Publications:**

- Gorak, Mark, *Lead-the-Fleet: A statistical analysis of the Lead-the-Fleet approach to changing aviation from a time based system to a usage based system*. Paper and Presentation at IIE conference. May 2004.
- Gorak, Mark, *A systems engineering approach of the Lead-the-Fleet program changing aviation from a time based system to a usage based system*, MORRS presentation, June 2004.
- Gorak, Mark, *A systems engineering approach of the Lead-the-Fleet program changing aviation from a time based system to a usage based system*, Operations Research Center of Excellence, Technical Report DSE-TR-04-06, June 2004.

**Personnel Briefed:**

- LTC Michael J. Kwinn Jr., PhD (ORCEN Director)
- Mike McFalls, LTF Program PM
- Bill Braddy, LTF Program Deputy PM
- MAJ Jong Lee, LTF Program Assistant PM

**Status:** Complete.

## ***Small UAV Analysis***

**DSE Project No: DSE-R-0407**

**Client Organization:** PEO Aviation, Redstone Arsenal, AL

**Senior Investigator:** Dr. Roger C. Burk, Ph.D

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
COL John D. Burke	Project Manager, Tactical Unmanned Aerial Vehicle Systems PEO Aviation Redstone Arsenal, AL 35898	256-895-4449	burkejd@tuav.redstone.army.mil
Mr. Jim Charlton	TUAVS PEO Aviation Redstone Arsenal, AL 35898	256- 895-4365	jim.charlton@ tuav.redstone.army.mil

### **Problem Description:**

The Program Manager for Tactical Unmanned Aerial Vehicle Systems has requested that a cadet capstone group investigate the optimal size and weight of unmanned aerial vehicles that are in the 0-50 lbs range, and are small enough to fit into a rucksack. The analysis should look at current capability within the industry and also at capability anticipated within 10 years. Current official statements of operational requirements can be used for background information or reference, but should not be regarded as strict guidelines.

### **Proposed Work:**

Investigate the mission/problem area and develop a study plan. Investigate aircraft capabilities and availability now and in 10 year. Investigate payload capabilities and availability now and in 10 years. Analyze and trade off platform weight vs. payload, for the present and for 10 years in the future. Assess cost/performance tradeoffs. Assess system data flow.

### **Results Summary:**

At the client's request, we narrowed the investigation to micro-UAVs weighting five pounds or less. We developed a stakeholder analysis and a system decomposition. Our futures analysis included three small scenarios or vignettes describing how a micro-UAV would be used. This led to a functional analysis, a value hierarchy, and non-linear additive value model.

To generate alternatives, we researched existing systems and identified three that passed feasibility screening. Then we used a morphological box approach to develop four logical system designs for future systems. The seven alternatives were scored using the value model, and the winner identified as a future system dubbed the Pinnacle and featuring helicopter flight mode, electrical primary power, and autonomous control. The second-highest scorer was an existing fixed-wing UAV called the Raven. The recommendation to the client was to procure the Raven for immediate use, while pursuing the Pinnacle for future development.

**Project Deliverables and Due Dates:**

- Final Briefing: 4 May 04
- MORSS Presentation: 23 Jun 04

**Presentations and Publications:**

- Eissler, Burt, Heather Ritchey, William Yun. "Analysis of a Micro Air Vehicle for the Army." Presentation given at Redstone Arsenal, AL, 4 May 04.
- Eissler, Burt, Heather Ritchey, William Yun, Roger Burk. "System Analysis of a Micro Air Vehicle for the Army." Presentation given at the Military Operations Research Society Symposium, Monterey, CA, 23 June 2004.

**Personnel Briefed:**

- BG Joseph Bergantz (PEO Aviation)
- Mr. Jim Charlton (contractor support to PEO Aviation)

**Status:** Complete.



## ***High Energy Laser Weapons: Modeling and Simulations***

**DSE Project No: DSE-R-0408**

**Client Organization:** High Energy Laser Joint Technology Office (HEL JTO)

**Principal Analyst:** CPT Eric S. Tollefson, M.S.

**Senior Investigator:** Dr. Roger C. Burk, Ph.D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
Ed Pogue	HEL Joint Technology Office 901 University Boulevard SE, Suite 100 Albuquerque, NM 87106	(505)-248-8200	Ed.pogue@osd.mil
Glen P. Perram Professor of Physics	Department of Engineering Physics Air Force Institute of Technology 2950 P Street Wright-Patterson AFB, OH 45433-7765	(937)-255-3636 ext 4504	glen.perram@afit.edu

### **Problem Description:**

The HEL JTO is coordinating the services' efforts to develop high-energy laser weapons. As part of this effort, the JTO recognized the need for end-to-end modeling of such weapons. Physics-based models exist for laser generation, beam formation and control, atmospheric propagation, and target interaction, but the JTO has no available model for a complete laser weapon shot ("photon birth to death"). Higher-level models of a military engagement, the execution of a military mission, or they carrying out of a campaign involving HEL weapons are also unavailable. It is clear that low-level, very detailed, physics-based models need to be linked in some way to higher-level engagement, mission, and campaign models, but it is unclear how this linkage should be worked.

To fill this gap, the HEL JTO asked the two service graduate schools of engineering (AFIT and NPS) and the three service academies (USMA, USNA, and USAFA) to form a consortium to research what modeling is required and to develop a model or family of models to meet the JTO's needs. AFIT agreed to lead this effort and the other institutions agreed to participate in ways appropriate to their capabilities and areas of responsibility.

The objectives of the effort are: (1) to develop a tri-service research team to integrate DoD fundamental research in end-to-end HEL modeling; and (2) to develop a government-owned, DoD-accepted global interface, which integrates existing and future HEL models. The initial focus must achieve a balance between (1) on-going, high-fidelity technical analyses, (2) engineering trade studies, which allow analyses of a wide range of systems, not simply a deep

analysis of any one selected system, and (3) analyses of HEL systems' military utility against a broad range of missions.

The lion's share of the effort will be with AFIT, as the institution with by far the greatest expertise and experience with high energy lasers. The participation of USMA will primarily in evaluating how HELs are or should be modeled in ground warfare and air and missile defense scenarios, and in helping develop linkages from physics-based models to higher-level engagement, mission, and campaign models.

#### **Proposed Work:**

This was the second year of a five-year, three-phase project. This year started Phase II, Model Development. The nature and scope of the USMA contribution to the project was to be worked out in coordination with AFIT in the first months of the academic year.

#### **Results Summary:**

We completed our review of Army combat modeling of laser weapon systems and published the resulting technical report. This review revealed no opportunity for us to make an important contribution to the HEL JTO project. It became clear that the core issues were in the areas of laser physics and laser systems engineering, and so outside of our areas of expertise. HEL JTO wanted Army representation on the project, and representatives from the US Army Space and Missile Defense Command offered to take that role, since they have the necessary background. Accordingly, the ORCEN dropped back to a review-and-monitor role on the project.

#### **Publication:**

- Delong, Suzanne O.; Tollefson, Eric S.; Burk, Roger C. *Modeling of HEL Weapons in Army Combat Simulations*. Operations Research Center of Excellence, Technical Report DSE-TR-03-02, September 2003.

**Status:** Complete.

***Base Realignment and Closure (BRAC) 2005: Army Installation  
Military Value Analysis***

**Research Project No: DSE-R-0409**

**Client Organization:** Deputy Assistant Secretary of the Army (Infrastructure Analysis)

**Principal Analysts:** LTC Willie McFadden, Ph.D., LTC Michael J. Kwinn, Jr.,  
Ph.D., MAJ John Harris, M.S.

**Senior Investigator:** Dr. Gregory S. Parnell, Ph.D.

**Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Dr. Craig College, Deputy Assistant Secretary of the Army (Infrastructure Analysis)	Army TABS Office 1400 Key Blvd, Suite #2 Arlington, VA 22209-1518	(703) 697-3388	craig.college@us.army.mil
COL William Tarantino, Chief, Modeling Support Team	Army TABS Office 1400 Key Blvd, Suite #2 Arlington, VA 22209-1518	(703) 696-9529	william.tarantino@us.army.mil

**Problem Statement:**

The purpose of this research project is to provide Base Realignment and Closure (BRAC) 2005 infrastructure analysis support to Dr. Craig College, Deputy Assistant Secretary of the Army (Infrastructure Analyses) and the Total Army Basing Study (TABS) Group. There have been four previous BRAC rounds in 1988, 1991, 1993 and 1995, during which defense officials picked 97 major domestic bases for closure, 55 major bases for realignment and 235 minor installations to be either closed or realigned. The BRAC 2005 round will be part of the Defense transformation effort with strong involvement of the OSD and Joint Staff. The services developed their BRAC methodologies in 2003-2004. The installation data call was conducted in 2004. The BRAC Commission will be formed in 2005 to recommend realignments and closures to the SECDEF and President. We developed and are implementing a methodology to assess the military value of each Army installation and the total Army infrastructure.

**Scope of Work & Methodology:**

The following are our major research objectives:

1. Identify key BRAC infrastructure and installation transformation issues and opportunities through research and interviews with Army senior leaders.
2. Develop an objective, credible, and auditable methodology for BRAC Army infrastructure transformation analysis and installation Military Value Analysis that will support senior Army decision makers.
3. Implement the Army Military Value Model using approved decision support software.
4. Write a white paper that describes the recommended methodology to support BRAC decision making.
5. Conduct a cadet capstone research project to assess BRAC historical performance, develop a BRAC implementation complexity model and identify BRAC performance measures.

#### **Methodologies:**

The methodologies we are using are stakeholder analysis, Multiple Objective Decision Analysis, and portfolio analysis using optimization.

#### **Results Summary:**

The following is our status for each objective:

1. Identify key BRAC infrastructure and installation transformation issues and opportunities through research and interviews with Army senior leaders.
  - a. We interviewed over 30 Army senior leaders. We documented the findings in our methodology report.
2. Develop an objective, credible, and auditable methodology for BRAC Army infrastructure transformation analysis and installation Military Value Analysis that will support senior Army decision makers.
  - a. The preliminary qualitative framework has been developed and approved by Dr. College.
  - b. We developed the quantitative evaluation measures and value functions for each installation Military Value criteria.
3. Implement the Army Military Value Model using approved decision support software.
  - a. We helped develop the model using Logical Decisions. The model has been implemented by United States Army Concept Analysis Agency.
4. Write a white paper that describes the recommended methodology to support BRAC decision making.

- a. The paper was completed in Spring 2004. The paper has not yet been released for publication.
5. Conduct a cadet capstone research project to assess BRAC historical performance, develop a BRAC implementation complexity model and identify BRAC performance measures.
  - a. The BRAC 2005 Implementation Cadet Project was started in January 2004 and completed in May 2004. The technical report was completed in August 2004.

**Presentations and Publications:**

- “Army Installation Military Value Assessment,” Presentation at INFORMS 2003, Atlanta, GA, October 19, 2003.
- Parnell, G., Harris, J. Hoops, B. Gardner, S., and Mounts, R., *BRAC 2005 Implementation Decision Support Tools*, ,Operations Research Center Technical Report, DSE- TR-0409, DTIC # ADA426284, United States Military Academy, August 2004.

***Publications Planned:***

- Methodology paper completed in Spring 2004. Not yet releasable for publication.
- Harris, J. and Parnell, G. S., “BRAC 2005 Implementation,” American Society for Engineering Management 25th National Conference, Alexandria, Virginia, October 20-23, 2004

**Personnel Briefed:**

- Dr. Craig College, Deputy Assistant Secretary of the Army (Infrastructure Analyses), several presentations.

**Status:** Research will continue in FY05.

***Base Camp Analysis: Location, Layout and In-Theatre  
Infrastructure Assessment***

**DSE Project No: DSE-R-0410**

**Client Organization:** Construction Engineering Research Laboratories (CERL)

**Principal Analyst:** MAJ John Cushing, M.S.  
**Senior Investigator:** LTC Timothy Trainor, Ph.D.

**Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER / EMAIL:
Deb Curtin	Engineer Research and Development Center Construction Engineering Research Laboratories 2902 Newmark Dr. Champaign IL 61822	(217) 398-5567	Deborah.R.Curtin@erdc.usace.army.mil
Stuart Foltz	CFF Engineer Research and Development Center Construction Engineering Research Laboratories PO Box 9005 Champaign, Ill 61826	(217) 373-3487	Stuart.D.Foltz@erdc.usace.army.mil
Richard Marvin Marlatt	Associate Technical Director Facility Acquisition & Revitalization Engineer Research and Development Center PO Box 9005 Champaign, Ill 61826	(217) 373-7290	Richard.M.Marlatt@erdc.usace.army.mil
Kirk McGraw	Research Structural Engineer Engineer Research and Development Center Construction Engineering Research Laboratories PO Box 9005 Champaign, Ill 61826		Kirk.D.McGraw@erdc.usace.army.mil

**Problem Statement:**

The military increasingly needs to plan for, and execute, fast deployments of forces in support of the full continuum of military operations, from combat, peace enforcement, peacekeeping, training and stability and support operations. The Army needs the ability to plan quickly the location, layout and operations of the bases to sustain deployed forces. Planners at the theater level require the doctrinal and technological support necessary to plan, construct, operate and close base camps that are secure, efficient and environmentally sound. Future sustainment areas will be placed throughout the depth of the battlefield to include deep, close and rear areas. Base camp development in these areas will need to be fast, while fulfilling mission, security and environmental requirements.

**Scope of Work & Methodology:**

The Departments of Systems and Civil and Mechanical Engineering at USMA assisted CERL in determining the requirements for infrastructure assessment and future base camp planning tools. The best way to gain a clear understanding of

the issues facing base camp planners was to provide a forum for personnel with base camp experience to discuss pertinent issues challenging those involved in establishing base camps of today and tomorrow. Subject matter experts across the United States military were invited to come to a base camp workshop conducted at the United States Military Academy. This workshop was instrumental in the stakeholder analysis process, a key component of an effective needs analysis. The intent of the workshop was to identify the key base camp issues to incorporate into a strategic plan of study and to garner support for continued work in this area. The end result of this workshop was to form "Tiger Teams" that could take the lead in finding solutions to systemic issues in the fundamental areas of initial planning, site selection, environmental, structures, energy and force protection.

To expand this work into the academic program, the Engineering Management Program identified a cadet capstone project to support CERL in the area of base camp planning, while the Civil Engineering Program offered an independent study to support CERL in the area of in-theater infrastructure assessment.

## **Results Summary:**

### **Base Camp Workshop**

The theme of the two-day workshop, held on 31 March & 1 April 2004, was "*Base Camps of Today and Tomorrow*." The first day was dedicated to base camp issues of today and the second day to base camps of tomorrow.

The first day began with a key note address by Brigadier General Merdith W.B. 'Bo' Temple, who is currently the commander of the North Atlantic Division Corps of Engineers. He had just returned from Iraq where he was the C7 (Engineer) of the Combined Joint Task Force Seven, Baghdad, Iraq. In his opening remarks BG Temple was able to set the stage for the first day's worth of discussions. He commented that even after being in Iraq for nearly a year the units were "still wrestling with the thorny issues of base camp development for such a large force." (Temple 2004)

Immediately following BG Temple's remarks, the participants were given a tactical scenario to help guide the discussion and were broken down into several breakout sessions. Participants were asked to focus their discussion in the fundamental areas: initial planning, site selection, environmental, structures, energy and force protection.

Each breakout session was asked to produce the following set of deliverables for each area:

- Identify 4 concerns within each topic area.
- Identify 4 recommendations for technology improvements
- Identify policy fixes needed for their issues
- Recommend potential lead agencies for researching solutions to the issues.

Each breakout session began their discussion focusing in a different fundamental area. The intent was for each participant to contribute to the area they came to the workshop to discuss and to ensure all areas were discussed by all groups in order to capture the broadest spectrum of issues and ideas. At the end of the day all the groups were brought together in a large group forum and asked to brief the deliverables from their breakout sessions. The intent of this briefing was to identify any consistent trends within the fundamental areas across groups. These trends would become the key issues to be addressed in the strategic plan and studied further by the future "Tiger Teams."

Day 2 also began with a key note speaker. Colonel Tom O'Donovan, who is currently the Director of Training for the United States Army Engineer School, gave a future Engineer Corps concept brief. This brief outlined the transformation process the Engineer force is currently planning to support overall Army transformation, and provided the context for each breakout session to discuss base camp operations of tomorrow in light of future transformation. The individuals were assigned to different breakout sessions for day 2 so we could ensure that each member would get to interact with different people and get a chance to express their ideas. Each breakout session was required to produce the same deliverables but this time in the context of base camps of tomorrow. At the end of day 2 all the breakout session groups reconvened and discussed their deliverables, with the intent to identify trends within each fundamental area.

#### **"Base Camps of Today" Breakout Session Trends**

The following section provides a consolidated list of the broad issues discussed during Day One by the breakout session groups in each fundamental area and serves as the trends for future study.

##### Initial Planning

- Need to determine the level that the initial plan pertains to and determine who approves and makes changes.
- Initial planning process needs to be standardized in the joint arena (i.e. span across all military services).
- Initial plan needs to determine civilian contractor requirements.
- Need to develop and follow a standardized flexible master plan for base camp layout.
- Need to fully develop / understand the operational mission in developing base camp plans.

##### Site Selection

- Ensure the site has the flexibility to allow for future expansion.
- Obtain site history in the following areas as part of the planning/selection process:



- Local populace
  - Political situation
  - Threats
  - Terrain and infrastructure analysis
- Must evaluate existing infrastructures for integration with the base camp plan.
- Need to determine who has the authority for base camp design changes.

#### Environmental

- Determine a common set of laws and standards to apply in base camp planning and management.
- Develop a plan for hazardous materials: collection, movement and disposal.
- Use onsite, deployable environmental assessment tools already available.

#### Structures

- Consider the following when designing structures for the base camp:
  - Life expectancy of base camp
  - Ease of future upgrade
  - Survivability
  - Integrate structures planning with deployment/redeployment considerations
- Conduct a thorough infrastructure assessment of existing structures.
- Determine the assets available for construction.
  - Engineers
  - Transportation
  - Materials
  - Terrain
- Develop a joint, integrated toolbox
  - Integrated planning software
  - Base camp templates
  - Library of existing base camp plans

#### Energy

- Develop energy requirements keeping in mind that these requirements creep up as base camps mature.

- Develop an energy transformation plan
  - tactical
  - medium voltage
  - high voltage
  - commercial
- Ensure the efficiency of existing power and use.
- Restore and protect the host nation power assets.
- Improve the United States' deployable power generation capability.

#### Force Protection

- Develop joint standards/requirements for force protection considering the following:
  - Distance from roads
  - External barriers
  - Entry and exit points
  - Lighting
- Integrate existing technologies into force protection plans:
  - Use of sensors
  - Voice, retinal, facial recognition

#### **“Base Camps of Tomorrow” Breakout Session Trends**

The following section provides a consolidated list of the broad issues discussed by the breakout session groups during Day Two in each fundamental area and serves as the trends for future study.

#### Initial Planning

- Research and have available knowledge of the operational environment such as:
  - Resources available
  - Personnel available
  - Permissibility of the environment
- Ensure joint integration to develop master plan.
- Integrate efficient use of Joint Engineer Planning and Execution System (JEPES).
- Identify the Base Camp commander as early as possible.

- Task the Engineer Research and Development Center to develop planning tools for vulnerability and survivability assessment.

#### Site Location

- Determine land requirements for particular sizes of forces.
- Use existing GIS technology to aid in the site selection process.

#### Structures

- Determine requirement list for structures needed keeping in mind the following:
  - Light, rapid deployment
  - Modular, low-cost, multi-purpose
  - Survivability, capabilities
  - Durability/easily reusable
  - Upgradeable
  - Compatible
  - Availability
- Make innovative use of existing materials.

#### Environmental

- Identify base camp proponent
  - US Army Training and Doctrine Command (TRADOC) or the US Army Engineer Community should take the lead on developing policy

#### Energy

- Develop an updated power system
  - Modular, deployable sets
  - Update power management capabilities
- Develop common standards across all branches of service pertaining to energy requirements.

#### Force Protection

- Establish standards for blast and ballistic protection for force protection items.
- Develop and enforce a standard base camp security operating procedure.
- Ensure or develop sensor integration between the tactical unit and sensor.

- Task the Engineer Research & Development Center to research the following force protection measures:
  - Sensor fusion
  - Blast and Ballistic Protection
  - Advanced materials

**Presentations and Publications:**

- Cushing, John C. and Trainor, T. *Developing Base Camps to Support Military Operations in a Dangerous World*, Proceedings of the American Society of Engineering Management 25<sup>th</sup> National Conference, October 2004.

**Status:** Complete w/continuing work under new project.

## ***Logistics Decision Support System***

**Research Project No: DSE-R-0416**

**Client Organization:** Logistics Officers (Support Platoon Leader, Battalion S-4)

**Principal Analysts:** MAJ Holly F. West, M.S., MAJ Elizabeth W. Schott, M.S.,  
CPT James Jackson

**Senior Investigators:** Dr. Gregory Parnell, Ph.D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
COL David Coker	Project Manager, Logistics Information Systems Ft. Lee, VA		cokerd@lee.army.mil
Mr. Jim Washburn	Deputy PM, Logistics Information Systems Ft. Lee, VA	804-734-7662	wasburnj@lee.army.mil

### **Problem Description:**

Currently, there are no tools designed to assist the maneuver battalions in daily logistics forecasting. Maneuver battalions forecast their logistics requirements, then support units incorporate these requirements into their logistics planning. Consequently, good forecasts can greatly aid the resupply process, while the effects of poor forecasting can be felt throughout the entire supply chain. The responsibility for these requirements typically falls to maneuver battalion officers and noncommissioned officers who have little, if any, logistics training. As the only tools available are designed for Brigade Level and higher forecasting, often these forecasts are poor, and the result is a stressed supply system.

### **Proposed Work:**

We propose to develop a tool geared towards the officers and non-commissioned officers in a maneuver battalion who are serving in logistics positions. This tool will be developed on Microsoft Excel and converted to an application that can be used on a handheld device. The decision support system that we propose would be extremely user friendly and would increase the accuracy of supply forecasts, while reducing the time it takes to determine these forecasts.

### **Results Summary:**

We conducted an initial Stakeholder's Analysis to properly define the problem. During our research it was evident that no tools existed to support this problem. Therefore, we developed several prototypes. The first of which was in Excel.

This spreadsheet while very useful, proved to be cumbersome, and not useful to the platoon leader. Our next prototype was formatted similar to the Excel Worksheet but was written in Palm Application Code for a Palm Pilot.

**Deliverables:**

- Excel Prototype--Complete
- Palm Prototype--Complete

**Presentations:**

- West, Holly F., Schott, Elizabeth, and Jackson, James. *Logistics Decision Support System*, Military Operations Research Symposium, June 2003.
- West, Holly F., Schott, Elizabeth, and Jackson, James. *Logistics Decision Support System*, Military Operations Research Symposium, June 2004.

***Pending Publications:***

- West, Holly F., Schott, Elizabeth, "Requirements Analyzer, A Tool to Assist Platoon Leaders." Army Logistician, Jan 2005.

**Status:** Research Ongoing

## ***Information Quality & Service Reliability***

**Research Proposal No.: DSE-R-0417**

**Client Organization:** Office of Force Transformation, OSD

**Senior Analysts:** Dr. Edward Pohl, Ph.D., Dr. Michael Tortorella, Ph.D.,

**Senior Investigator:** Dr. Patrick J. Driscoll, Ph. D.

### **Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Gary A. Agron, LTC (P) Transformation Strategist	OSD Office of Force Transformation 1401 Wilso Blvd, Ste 301 Arlington, VA 22309-2306	703.696.5716 (DSN 426)	gary.agron@osd.mil

### **Problem Description:**

Given the dependency of the NCW/NCO framework upon mixed-sensor networks and information networks in general, we propose to develop a stochastic framework to assess the reliability of information products manufactured by these networks and the subsequent impact of this reliability upon the precision, accuracy and confidence associated with these products.

We undertake a study to develop quantitative metrics based on the concepts of information quality and service reliability for the elements of the NCO CF framework. Specifically, we intend to examine the appropriateness of these metrics using both the case studies developed under contract by OFT and the data resulting from recent C2 experiments.

### **Scope of Work & Methodology:**

- Properly develop a new generalized framework for measuring information quality based on concepts of reliability and network information services that can be applied to elements of the NCO framework.
- Incorporate into the framework the appropriate service reliability and information manufacturing concepts using the TRADOC sensor network experimental results. Identify and extrapolate their impact on critical dimensions of situational awareness and decision making in the NCO environment.

### **Results Summary:**

A comprehensive literature search was conducted in both areas of focus. We developed an information manufacturing framework capable of illustrating the linkage between quality and service reliability and have decomposed both

concepts into working elements that can be applied to case studies. We have begun applying a select number of reliability and strength of inference metrics to the NCO structure. We have also proposed a modification to the original NCO conceptual framework with regards to quality of information, adjusting the criteria and categories to align with current theoretical results.

**Presentations and Publications:**

- *Information Reliability & Uncertainty in NCO Systems*. With Ed Pohl, Michael Tortorella. Presented at the INFORMS Annual Conference, Denver, Colorado, October, 2003.
- *NCW Conceptual Framework and Uncertainty*. With Ed Pohl and Mike Tortorella. Presented at the CORS/INFORMS Joint Annual Conference, Banff, Canada, May 2004.



## ***Information Logic & Impact of Incomplete Information***

**Research Proposal No.: DSE-R-0418**

**Client Organization:** Office of Force Transformation, OSD

**Principal Analyst:** LTC Pamela Hoyt, M.S., CPT Steven Henderson, M.S.

**Senior Investigator:** Dr. Patrick J. Driscoll, Ph. D.

### **Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Gary A. Agron, LTC (P) Transformation Strategist	OSD Office of Force Transformation 1401 Wilso Blvd, Ste 301 Arlington, VA 22309-2306	703.696.5716 (DSN 426)	gary.agron@osd.mil

### **Problem Description:**

This study focuses on using network learning techniques in conjunction with sensor information flow to estimate a force's operational state as a proxy for their intent. Ultimately, we are attempting to quantify the notion of *leveraging information* to gain unsurpassed battlefield dominance by a transformed Army.

We also propose that returning to a first principles approach toward structuring the information organization required to support such an algorithm would be beneficial.

### **Scope of Work & Methodology:**

- Develop a general information framework based on operational states, key descriptors, and an associated logic structure.
- Develop a stochastic method for binning battlespace observations that will enable us to detect and classify new key descriptor evidence emerging in real time.
- Demonstrate the effectiveness of this approach using several major inference network models.
- Quantify the notion of information advantage.
- Develop a methodology for dynamically adjusting the partitioning of information between known and unknown elements in order to identify and characterize thresholds at which decisions can be safely made.
- Identify the threshold levels at which a decision maker is 'safe' in making inferences concerning population characteristics (aka: target identifiers) in the face of missing data and/or information.

### **Results Summary:**

We developed and tested a prototype framework called a meta-model intended to house several automated learning inference techniques. This framework is based on a finite set of operational states being decomposed into a finite set of key descriptors (not assumed to be mutually exclusive) that accumulate evidential support from sensor network flows. We also demonstrated the feasibility of reducing the information needed to identify and classify enemy operational states based on restricted sensor input.

In this vein, we applied three different network simulations: Bayesian Belief Networks, Modal Logic, and Fuzzy Set Membership, to demonstrate that a simplified information organization structure based on core information requirements is sufficient to accurately classify operational states. We established both end-state and time-evolving performance metrics for each system in order to compare the static and dynamic performance and are currently in the process of analyzing computational results based on these metrics.

We also have designed a Bayesian-based method for dynamic partitioning of data in support of network learning and have proposed a new method for interleaving discretization of continuous variables and network learning for classification. Code development for computational testing is underway.

### **Presentations and Publications:**

- *Identifying Unknown Force Operational States.* With Steve Henderson. Invited presentation at the CORS/INFORMS Joint Annual Conference, Banff, Canada, May 2004.

## ***Simulation Roadmap for Program Executive Office (PEO) Soldier Programs***

**DSE Project No: DSE-R-0421**

**Client Organization:** Program Executive Office Soldier, Fort Belvoir, VA

**Principal Analysts:** CPT Eric Tollefson, M.S., CPT Gregory Boylan, M.S.  
**Senior Investigators:** LTC Michael Kwinn, Jr., Ph.D., Dr. Bobbie Foote, Ph.D.,  
Dr. Paul West, Ph.D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
Charles R. Rash (Deputy, PEO Soldier)	PEO Soldier 5901 Putnam Road, Bldg 328 Fort Belvoir, VA 22060-5422	703-704-1803 DSN 654-1803	charles.rash@peosoldier.army.mil
Charlie Tamez (Systems Integration)	PEO Soldier 5901 Putnam Road, Bldg 328 Fort Belvoir, VA 22060-5422	703-704-4073 DSN 654-4073	charlie.tamez@peosoldier.army.mil

### **Problem Statement:**

**Background** - One of the primary challenges facing the United States Army acquisition community is that of quickly fielding technologically-advanced equipment to the force. The high cost of doing so brings with it significant risk, as demonstrated by the Crusader artillery and Comanche helicopter programs, both multi-billion dollar programs cancelled within the last two years. As a result, program managers must be able to reasonably guarantee the utility of their products early in the design phase and to continue doing so throughout the product's lifecycle. To that end, the Army has turned to simulation to evaluate the combat effectiveness of its proposed systems.

Unfortunately, the development of technological capabilities, especially with respect to information sharing, is outpacing improvements in current combat simulation capabilities. Moreover, until recently, the focus of the combat modeling community has been on large battlefield platforms and unit-level analyses. As a result, the representation of the individual soldier on the battlefield has not kept pace with other representations. These Infantry soldier models require unprecedented fidelity in terms of the soldier entity and his environment. The Program Executive Office Soldier (PEO Soldier), the Army program manager for the acquisition of nearly all the items carried or worn by the Infantry soldier, requires such high-fidelity models of the soldier in order to evaluate the

effectiveness of its products. They have realized that the existing simulation capability is not up to the task.

**Revised Problem Statement** - Identify and/or develop tactical combat simulation capability for Light Infantry missions at the level of Platoon and below with resolution down to the individual soldier. The simulation capability must accept, as input, scenarios and soldier tactical mission system (STMS) characteristics. It must model the functions of the soldier in a tactical environment, and provide, as output, the measures of effectiveness (MoEs) used to evaluate STMS. The simulation(s) will provide the analytical capability to support Program Executive Office (PEO) Soldier decision making.

### **Scope of Work & Methodology:**

We generally followed the framework of the Systems Engineering and Management Process (SEMP). Specifically, we conducted the following analyses.

#### **1. Problem Definition**

- a. Studied the Army acquisition process, the Army's Simulation and Modeling for Acquisition, Requirements, and Training (SMART) program, and current simulation technologies, in order to gain a better understanding of our task;
- b. Conducted a detailed search of relevant literature, focusing on related research, as well as DoD and Army regulations, policies, and guidelines;
- c. Interviewed key stakeholders throughout the Army community;
- d. Determined the required functions of the ideal simulation solution;
- e. Conducted a detailed requirements analysis of the representation of a soldier entity in simulation;
- f. Revised our initial problem statement into a complete engineering problem statement;
- g. Converted our analysis into a value model, using value-focused thinking, for use in comparing alternatives;

#### **2. Design and Analysis**

- a. Generated alternative solutions considering simulations existing or under development and new capabilities;
- b. Evaluated those alternatives based upon the predicted performance in the evaluation measures developed during value modeling;

#### **3. Decision-Making**

- a. Scored each alternative based upon their predicted performances for each evaluation measure;

- b. Compared the alternatives;
  - c. Conducted a sensitivity analysis;
  - d. Conducted a cost-benefit analysis;
  - e. Recommended an alternative;
4. Implementation
- a. Developed an initial list of tasks that need to be performed to implement the recommended solution
  - b. Began executing the implementation plan.

### **Results Summary:**

**Recommendation** We recommended to PEO Soldier that they pursue the modification of and linkage between the following three simulations currently under development: Combat<sup>XXI</sup>, the Infantry Warrior Simulation (IWARS), and Objective One Semi-Automated Forces (Objective OneSAF or OOS). Our analysis determined that the above recommendation offers the greatest benefit to PEO Soldier in terms of simulation capability and decision support. The following paragraphs discuss some of the intermediate results that led to our recommendation.

**Needs Analysis** Simulation model requirements flow from two primary needs: the need for a tool to compare candidate soldier tactical mission systems (STMS) and the need for realism. An STMS is any system, or system of systems, worn or carried by the Infantry soldier on the battlefield and includes such equipment as weapons, load-bearing equipment, communications devices, GPS devices, sensors, tools, etc. The proposed simulation model has to produce valid outcomes based upon the inputs. The outcomes normally desired are called measures of effectiveness (MoEs). MoEs used to evaluate an STMS would assess its mission capability and survivability (lethality, mobility, protection, communications, and situational awareness) and its trustworthiness (reliability, availability, maintainability, sustainability, and usability). An example of an MoE used to evaluate lethality is *total number of enemy kills*. Each MoE may depend upon a large number of measures of performance (MoPs). MoPs are lower-level measures that quantify the performance of a particular piece of equipment or human task. Using the lethality example, the total number of enemy kills may be a function of the following MoPs: weapon rate of fire, accuracy, reliability, human aiming error, target location error, etc. Thus, our recommended simulation needed to provide the required MoE output while allowing the user to alter the MoP inputs representing the unique characteristics of the STMS under study.

But how much realism is required? Resource and technology constraints dictate that we define an appropriate level of fidelity. The answer to that question depends primarily upon the purpose of the simulation. The purpose of our simulation was to provide a decision aid for comparing STMS configurations and

distribution. Therefore, we determined that the simulation model must represent STMS functions, including those inputs and outputs affecting or affected by the system being considered, while still producing a valid result. Otherwise, unique aspects of the systems being compared will not factor into the simulation output, potentially resulting in an uninformed decision.

**Requirements Methodology** To ensure that we captured the simulation requirements, we uniquely applied a combination of functional and input-output analyses to the soldier on the battlefield. We constructed a comprehensive hierarchy of the functions a soldier executes in the performance of his mission. For each of those functions, we identified the inputs transformed by the function and the outputs produced. We also captured the attributes of the soldier that affect how that soldier transforms inputs to outputs. As an example, consider the soldier function of choosing a target to engage. Inputs into this decision include the soldier's own location, the target location, the threat presented by the target, the soldier's perceived probability of hitting the target, other targets, the terrain, the weather, his sector of responsibility, his location in the formation, etc. The primary output is a target choice, which may be an input to the actual engagement function. Attributes of the soldier would include his training level, experience, doctrine, rules of engagement (ROE), role in the unit, etc. We conducted this type of analysis for each of the soldier's primary functions.

**Resulting Requirements** Our methodology led to a detailed document identifying over 130 soldier functions that need to be modeled, with inputs, outputs, and attributes. Additionally, our combination of functional decomposition with input-output analyses actually improved our understanding of the desired performance outputs, or MoEs. By identifying the inputs and outputs of every function, we were also identifying MoPs. Since those MoPs directly affect MoEs, we were able to identify unexpected sources of performance contribution that we would have missed using other methods. Thus, for a comparative analysis, our results give PEO Soldier a clearer picture of how their individual systems contribute to the effectiveness of the soldier system of systems.

**Design and Analysis** We generated a large number of alternatives from the following categories: 1) using existing simulation capabilities; 2) using simulations under development; 3) modifying simulations under development; 4) using a combination of the previous three categories; and, 5) creating a new simulation capability. However, not all of our initial alternatives were feasible. Our previous analyses (primarily our stakeholder analysis) revealed constraints that any candidate solution would have to satisfy in order to be considered further. We used those constraints to remove the alternatives that were clearly infeasible, leaving us with eleven alternatives. Existing simulations considered as part of those eleven alternatives were Janus, the Joint Conflict and Tactical Simulation (JCATS), OneSAF Testbed Baseline (OTB), Combat<sup>XXI</sup>, IWARS, and OOS.

We then modeled each of the alternatives to determine values for the evaluation measures we developed during our value modeling. Because of the types of measures we chose, the process of determining values for them was subjective. Additionally, all but three of the eleven alternatives were either under

development or did not exist at all. As a result, we had to estimate values based upon existing documentation, projected capability, and subject-matter expertise.

**Decision-making** We then scored and compared the alternatives. The alternative with the highest total value score was the modification of and linkage between Combat<sup>XXI</sup>, IWARS, and OOS. Because of the subjective nature of our weighting in the value model and in the creation of and scoring within our evaluation measures, we conducted extensive sensitivity analyses on our results. From those analyses, we determined that the highest-scoring alternative was not sensitive to the above subjectivity.

We also conducted an informal cost-benefit analysis. As with the other modeling we conducted, the determination of costs for alternatives that are still under development or not in existence was imprecise, at best. Thus we were only able to conduct an order-of-magnitude analysis. From that, we determined that the highest scoring alternative was still the best solution and it became our recommended alternative.

We presented our results and recommendation to our client on 14 May 2004.

**Conclusions** Each of the simulations in our recommended solution has unique strengths that, when combined, should have great synergistic effects on the resulting federation. IWARS will have tremendous strengths in terms of individual soldier modeling, whereas OOS and Combat<sup>XXI</sup> will have robust combined arms representations. Combat<sup>XXI</sup> will provide great analytical capability as a closed-loop simulation, whereas OOS' greatest strength will be in HITL. IWARS, designed for both types of human interaction, will be able to link to both by operating in either mode. OOS' environmental runtime component, being used by all three simulations, will facilitate a detailed representation of the environment. By being able to link to OOS, Combat<sup>XXI</sup> and IWARS will benefit from the numerous concurrent efforts being conducted to support OOS. Thus, where one simulation may have weaknesses, another simulation has strengths.

Finally, PEO Soldier support for efforts already underway conserves scarce resources and leverages valuable work already invested. Their support benefits the simulation proponents, as well, by adding value to their efforts and expanding their application areas. Clearly, this recommendation will benefit all involved.

#### **Presentations and Publications:**

- Tollefson, E. S., Kwinn, M. J., Jr., Boylan, G. L., Foote, B. L., and West, P. D., 2004, "A Needs-based Analysis of Analytical, High-Resolution Infantry Simulations," in *Proceedings of the 2004 IIE Annual Conference*, Houston, TX.
- Tollefson, E. S., Boylan, G. L., Kwinn, M. J., Jr., Foote, B. L., West, P. D., and Martin, P. G., 2004, "Using Systems Engineering to Define Simulation Requirements for the Acquisition of Infantry Soldier Systems," to be published in the *Proceedings of the ICSE & INCOSE 2004 Conference*, Las Vegas, NV.

- Tollefson, E. S., Boylan, G. L., Kwinn, M. J., Jr., Foote, B. L., and Martin, P. G., 2004, "Simulation Modeling Requirements for Determining Soldier Tactical Mission System Effectiveness," to be published in the *Proceedings of the 2004 Winter Simulation Conference*, Washington, D.C.
- Tollefson, E. S., Boylan, G.L., Kwinn, M.J., Jr., Foote, B.L., West, P. D., 2004, *Simulation Roadmap for Program Executive Office (PEO) Soldier*, Operations Research Center of Excellence Technical Report [DSE-R-0421], United States Military Academy, West Point, NY, to be published in August, 2004.
- Tollefson, E. S., Boylan, G. L., Kwinn, M. J., Jr., Martin, P. G., Foote, B. L., and West, P. D., 2004, "United We Stand: Leveraging Concurrent Efforts to Support Infantry Soldier System Acquisition," to be Presented at the INFORMS Annual Meeting 2004, Denver, CO.

**Personnel Briefed:**

- Presentation to Mr. Charles R. Rash, Deputy PEO Soldier, Initial Project Briefing – 14 November 2003.
- Presentation to Mr. Charles R. Rash, Deputy PEO Soldier, IPR #1 – 19 December 2003.
- Presentation to Mr. Ross Guckert, Director, Systems Integration, PEO Soldier, IPR #2 – 22 March 2004.
- Presentation to Mr. Charles R. Rash, Deputy PEO Soldier, Final Decision Briefing – 14 May 2004.



## ***Lifecycle Acquisition Management Project***

**DSE Project No: DSE-R-0424**

**Client Organization:** Defense Advanced Research Project Agency (DARPA) &  
PM Unit of Action (UA)

**Senior Investigators:** LTC Willie J. McFadden II, Ph.D.,  
Dr. Paul West, Ph.D., Dr. Niki D. Goerger, Ph.D

### **Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Dr. Myra Gray	PM UA Technologies 7990 Science Applications Court MS CV-51 Vienna, VA 22182		myra.gray@belvoir.army.mil
Dr David Hunter	PM UA Technologies Human Factors & Training 7990 Science Applications Court MS CV-51 Vienna, VA 22182	703-676-1327	david.hunter@belvoir.army.mil

### **Problem Statement:**

This project applies state-of-the-art technology tools to advance integrated project/program management and systems design. Using the Acquisition Systems Management Lab (AMSD), Combat Simulation Lab (CSL), and other capabilities in the Department of Systems Engineering at the United States Military Academy, this project will demonstrate the acquisition lifecycle benefits of using state-of-the-art tools, such as: shortened acquisition times, reduced costs, and enhanced processes from the use of transforming technology. All of these can be directly applied to future acquisition systems, processes, and to the fielding of Future Force units.

**Background:** The Department of Systems Engineering (D/SE) at the United States Military Academy is dedicated to providing an exceptional academic and research environment for our cadets and faculty. To achieve this vision, the D/SE emphasizes a culture of scholarly excellence through its faculty, academic programs, research, and technology initiatives. We have identified a critical military need to conduct research in acquisition management and systems design. The Army is in a transformation process that will position it to remain the world's dominant military force through the 21<sup>st</sup> Century. This transformation requires that our analysis tools be able to assess the potential of new systems much the same way we do today. However, it also requires that we develop systems to function within integrated, interoperable, multi-echelon information architecture, new force structures and enhanced management and leadership processes. This necessitates that we look to new analytic tools, models, simulations, and

federations of tools to effectively analyze the complex issues confronting our transformation efforts. These tools must be linked within a collaborative research and investigative environment that allows for a focused look at acquisition processes and policies.

### **Scope of Work and Methodology:**

The following are our major research objectives:

1. Development of a virtual, constructive, and live environment that has the appropriate technology and expertise to conduct cutting edge research on acquisition issues, systems design and experimentation, and exploratory analysis of proposed new doctrine and tactics techniques and procedures.
2. Army institutions are transforming to meet the many and diverse challenges it will face in the future. Likewise, the Army's acquisition process is also changing to be more responsive, cost effective, and efficient. The use of collaborative environments, continuous information exchange, and knowledge management marks the new manner program offices now need to conduct business to coordinate the many facets of a systems development. In this new business process, Program Managers (PM) must manage dynamic requirements throughout the lifecycle of a program.
3. Our forces are deployed into increasingly complex environments and are performing missions that are often not the focus of home station training. This requires the men and women of the Armed Forces to be critical thinkers to solve problems as they arise. These necessary responses usually get implemented as field expedient untested and unanalyzed tactics techniques and procedures. There is a need to assist our troops in the ability to rapidly and effectively incorporate new tested and validated tasks and TTP into their training. Through virtual environments it is possible to experiment and test new tasks and TTP.
4. Increasingly information visualization is becoming more important to decision makers. Situational Awareness leads to understanding. This is not only important to combat commanders, but it is also critically important to business executives, program managers, and our corporate DoD leadership. What information is presented, the sequence of the presentation, and the medium and formatting of the information profoundly affects decision making.
5. Knowledge management has increasingly become a hallmark in integrating within organizations and programs and between enterprises. The development of organizational knowledge analysis architectures will provide organizations with the required framework necessary to develop appropriate metrics of assessment.
6. In conjunction with new concepts, oftentimes new systems must be developed. Theorizing the physical and performance attributes of a system is difficult, but prototyping that system in constructive and virtual environments is often more difficult. Along with prototyping the system there is still the need to ensure that training, education, supportability, production, maintenance, etc. issues are addressed. Merging the system design within the engineering

management process is possible through the collaborative use of design and management software.

7. Acquiring of new systems faster and cheaper is the underlying goal of this program. Cost planning and execution internally to an acquisition program is critical to the success of acquiring the system. There is a need to review the regulatory requirements as they relate to expenditures to ensure that current and future policy supports efficient and effective business practices.

### **Results Summary:**

The following is our status for each objective:

#### **1. Adaptive Virtual Analytical Test and Research (AVATAR) Environment**

**Problem Statement:** Experience in Iraq, Afghanistan, and other recent Military Operations Other Than War (MOOTW) highlight the need for validated, innovative tactics, techniques and procedures (TTPs) to combat adversaries who are adaptive in their tactics. The existing suite of Army simulations is not focused on the rapid, quantitative exploration of emerging TTPs in such non-traditional environments.

**Project Description:** The Department of Systems Engineering, USMA, will develop an analytical environment to evaluate prospective TTPs for asymmetric operations in Combined and Joint MOOTW. It will support the tenets of Simulation Based Acquisition (SBA) and Simulation and Modeling for Acquisition, Requirements, and Training (SMART). Specifically, DSE will:

- Develop a full-scale virtual environment in which soldiers can conduct experiments in dynamic situations against adversaries who are live, virtual, constructive, or in any required combination. The term, "avatar," refers to a synthetic human surrogate in a virtual environment.
- Design an analytical framework for developing and evaluating alternative solutions to identified acquisition needs.
- Develop a methodology roadmap for designing and testing candidate systems across constructive, virtual, and live simulation domains.

The project spiral development plan is illustrated below, along with annual technology thrusts, leveraging projects, and budget forecasts.

The plan consists of three research and development (R&D) phases and a capstone exercise. Each phase builds on and enhances those before it, as well as adds new capability. Further, each phase is developed considering the needs of follow-on phases and is capped by a validation experiment. The project concludes

with a capstone experiment exercising all aspects of the combined technology in a distributed constructive, virtual, and live simulation.

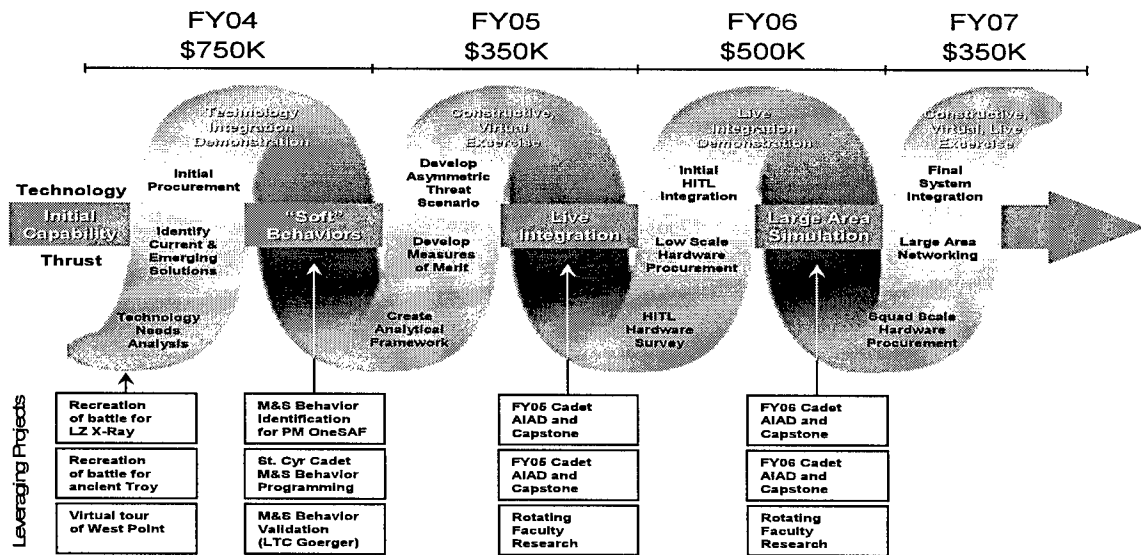


Figure 1: AVATAR Spiral Development Plan

**Technology Thrusts:** Each phase focuses on a major integrative technology thrust. These thrusts are:

- Year 1: Provide a foundation and initial capability and included an initial technology needs analysis and identification of relevant current and emerging capabilities.
- Year 2: Explore and apply of "soft" behaviors such as leadership and morale in a combined constructive and virtual environment.
- Year 3: Integrate live simulation into the constructive/virtual environment using state-of-the-art human instrumentation.
- Year 4: Conduct a large-area constructive/virtual/live simulation exercise with at least a squad-sized live force in a tactical operation in West Point's Camp Buckner training area.

Sub-tasks supporting these thrusts include the design and development of an analytical framework, development of measures of merit, development of one or more appropriate asymmetric threat scenarios, human-in-the-loop (HITL) hardware and software integration, and large area, duplex simulation communication.

**Milestones:**

Major milestones for each phase and scheduled project quarter are shown below:

**Phase 1:**

Conduct technology needs analysis	Q1
FY04	
Identify existing and emerging technology solutions	Q2
FY04	
Procure selected technology	Q4
FY04	

**Phase 2:**

Experiment 1: Technology Integration with Asymmetric Threat Unit	Q1
FY05	
Develop framework for analysis in the AVATAR environment	Q2
FY05	
Conduct comparative analysis of distributed simulation technologies	Q2
FY05	
Experiment 2: Distributed AVATAR-to-AVATAR Simulation	Q4
FY05	
Interim Technical Report and IPR	Q4
FY05	
Identify live simulation technology solutions	Q1
FY06	
Procure selected live simulation technology	Q3
FY06	
Initial constructive/virtual/live integration	Q4
FY06	

**Phase 3:**

Experiment 3: Large-Area Constructive/Virtual/Live Exercise	Q3
FY07	
Final Technical Report and Briefing	Q4
FY07	

**Status of Work Completed:**

All objectives for Phase 1 have been met.

**Objective 1** (Conduct technology needs analysis) and

**Objective 2** (Identify existing and emerging technology solutions):

Quantitative and qualitative assessment of TTPs involving real-time human interaction in life-threatening scenarios requires a stimulus-rich immersive virtual environment capable of interaction with a live and/or computer-generated threat in a realistic, controlled environment.

The Army and DOD maintain and are developing a large number of constructive simulations that provide the highest-available fidelity of combat systems and interactions. The project approach is to acquire the "best of breed" of DOD constructive simulations to allow researchers to integrate appropriate capabilities for given scenarios. Simulations supporting this objective include the following:

- OneSAF Testbed
- Objective OneSAF (beta build)
- Joint Conflict and Tactical Simulation (JCATS)
- Extended Air Defense Simulation (EADSIM)
- Janus
- WARSIM

Two primary techniques of virtual immersion exist: local-tethered immersion, typified by head-mounted displays; and local-untethered immersion via a Computer-Augmented Virtual Environment (CAVE). For this discussion, tethered refers to the environment being physically attached to the subject. It may also be tethered to the host computer by cables or may be wireless. These techniques may be combined using transparent HMD media, providing a heads-up-display (HUD)-like image that can portray battle command information or other data. CAVE technology provides a room with up to six sides, each of which is projection screen providing a life-sized display of the environment. It may be enhanced by sound and/or a motion platform.

The full spectrum of asymmetric threat scenarios requires conditions beyond those of a climate-controlled laboratory and an adaptability and reason beyond the capabilities of today's computers. This requires a field component in which human subjects must interact with computer-generated forces, live forces, or both.

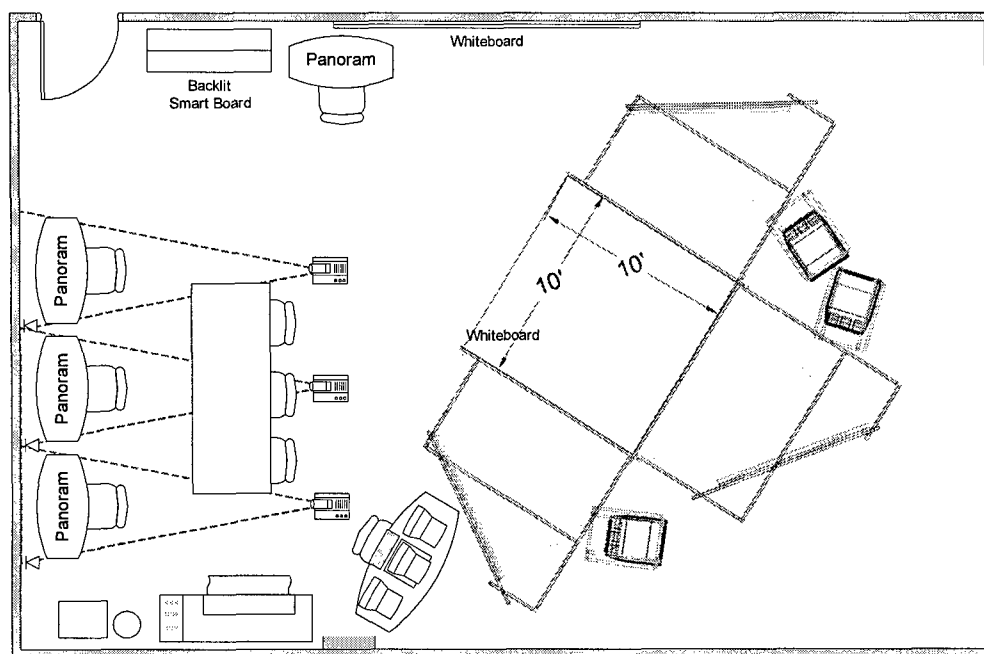
Each component of a comprehensive constructive/virtual/live environment must support the other two. All components must share entity information seamlessly, so that entities in one medium and interact flawlessly with those in the others. Two approaches are widely supported within DOD to meet this requirement. The first, Distributed Interactive Simulation (DIS), has been used extensively since standards for it emerged in 1991, following the DARPA Simulator Networking (SIMNET), project of the 1980s. The DIS Protocol, now an IEEE standard, uses a suite of Protocol Data Units (PDUs) to share critical information such as entity state, fire, collision, and communication among all simulators on the network. The second approach, High Level Architecture (HLA), was developed in the mid-1990s under the auspices of the Defense Modeling and Simulation Office (DMSO) to enhance simulator communications and overcome limitations of DIS.

HLA provides a set of rules for participation, an interface specification, and a model template for participating objects. Individual simulators are “federates” in the larger federation of simulations comprising the exercise.

**Objective 3** (Procure selected technology):

a. Facility and Hardware. The AVATAR Environment prototype is under development in Room 406A of Mahan Hall at the US Military Academy at West Point. It is located in the Acquisition Management and System Design Lab (AMSD) within the Department of Systems Engineering (DSE). The lab is designed to provide battle command, virtual prototyping, and end-to-end acquisition lifecycle design capabilities. The layout of the AMSD is shown in Figure 2.

The AMSD layout is modeled on a Command Post of the Future (CPOF) prototype designed by DSE. It consists of four workstations, each with three-screen flat panel displays. The three primary workstations are tied to ceiling-mounted projector aimed at a screen above and in front of the workstation. Any one of the three workstation screens can be sent to the projector for commander assessment. A rear-projection SMART Board system flanks the fourth workstation, and can access any PC via Remote Desktop or SynchronEyes workstation sharing technology. The SMART Board system provides on-screen note-taking and saving as well as touch screen capability. A color 3D printer provides the ability to create three-dimensional, physical models from computer-aided design (CAD) software.



**Figure 2: AMSD Lab Layout**

The lab also contains a three-sided (10'x10'x8') CAVE with 5.1 Surround sound. A contract has been awarded to upgrade the CAVE to four sides (including a floor/ground image) with enhanced rear-screen projectors. An InterSense motion tracking system has been added that can "digitize" a human in the CAVE and insert the virtual representation into a constructive simulation. The CAVE also is capable of active-stereo 3-D visualization for enhanced immersion. Also integrated into the CAVE is a 3-D Data Glove which allows subjects to touch, hold, and manipulate virtual objects in the 3-D space.

The CAVE is powered by three (upgrading to four) workstations at an external operator's station. Three monitors display the same images as the three walls of the CAVE and also can be operated in active-stereo 3-D mode. An additional feature of the three workstations described initially is that they can also display images of the three walls of the CAVE, one via each projector. The combined capability allows the commander or decision maker to simultaneously visualize any four of the 16 different displays in the lab.

b. Software. AVATAR software is generalized in four categories: constructive simulation, virtual run-time, development tools, and hardware support.

- 1) Constructive simulation. Several DOD simulation packages have been integrated to provide the broadest spectrum of synthetic warfighter capabilities. The primary simulations are OTBSAF and Objective OneSAF, Extended Air Defense Simulation (EADSIM), and the Joint Conflict and Tactical Simulation (JCATS). Others are available if required.

- 2) Virtual run-time. This includes all visualization software that renders entities from the constructive simulations using 3-D models. Two applications in use for CAVE visualization are the commercial-off-the-shelf (COTS) tool, VegaPrime, by Multigen-Paradigm, Inc., and Delta3D, an open-source project under development at the Naval Postgraduate School in Monterey, California. Two so-called "stealth" visualization tools are also being used to allow observers to move undetected through the battle space. These are especially useful for scenario validation and after action reviews (AARs). These two applications are the COTS product, Stealth, by Mak Technologies, and the government-off-the-shelf (GOTS) product, "SOFViz, developed by Terrex, Inc., under contract with the Army's Special Operations Command.

- 3) Development tools. In addition to Java and C++ compilers and Integrated Development Environments (IDEs), the primary development tools are Creator and LynxPrime, both by Multigen-Paradigm, Inc., and DI-Guy, DI-Guy Scenario, and DI-Guy Behavior Editor, all by Boston Dynamics, Inc. Creator is a 3-D visual modeling tool that generates industry-standard OpenFlight format files for 3-D run-time systems. LynxPrime is a graphical interface for developing scenarios for VegaPrime. The DI-Guy suite allows for the creation and modification of fully articulated virtual human models in the run-time environment.



c. Collaborative Partnerships. Coordination, information, and research relationships have been established with the Virginia Modeling Analysis Simulation Center (VMASC), the Naval Post graduate School's Modeling, Virtual Environments, and Simulation (MOVES) Institute, as well as subject matter experts (SMEs) at the Program Executive Offices (PEOs) for Soldier and Simulation, Training and Instrumentation (STRI).

Within USMA, several leveraging projects have either been completed or are underway to enhance the body of knowledge support the AVATAR Environment. These include the creation of a web-based virtual tour of West Point using the Virtual Reality Modeling Language (VRML), recreations within constructive simulation of the battle of Gettysburg, Waterloo, LZ X-Ray (Vietnam), 73-Easting (Desert Storm), and the Thunder Run through Baghdad in Operation Iraqi Freedom. Most recently, the capabilities of DOD constructive combat simulations were challenged through a recreation of the battle for ancient Troy, conducting in cooperation with USMA's Department of English. Additionally, a SME whose doctoral dissertation was on the validation of behaviors in constructive simulations has agreed to participate.

Two behavioral analyses using virtual environments have been conducted in cooperation with the Engineering Psychology program in the Department of Behavioral Science and Leadership (BS&L). The first, Quantifying the Value of Dynamic Visual Perspectives in Target Identification Training, focused on the value-added of 3-D training for combat identification versus the traditional "flash card" method. The second, Comparative Assessment: Situation Awareness Global Assessment Technique (SAGAT) vs. Geographical Recall and Analysis of Data in the Environment (GRADE), evaluated two situation assessment tools using scenarios generated by OTBSAF and visualized using the Mak Stealth product.

**Issues to Report:** None

## **2. Dynamic System Requirements Management.**

**Problem Statement:** Army institutions are transforming to meet the many and diverse challenges it will face in the future. Likewise, the Army's acquisition process is also changing to be more responsive, cost effective, and efficient. The use of collaborative environments, continuous information exchange, and knowledge management marks the new manner program offices now need to conduct business to coordinate the many facets a systems development. In this new business process, Program Managers (PM) must manage dynamic requirements throughout the lifecycle of a program. In the case of the most systems, requirements may be specified from sources such as the Joint Service Operational Requirement (JSOR), Required Operational Capabilities (ROC), and Operational Requirements Document (ORD). Or, they are implied or derived requirements such as safety, human factors, commercial standards or specifications, system specification, or purchase description.

**Project Description:** In achieving this objective our efforts have been devoted to identifying a new technology program that is in its early stages of development and applying a comprehensive dynamic systems requirements analysis on said project. Our initial efforts were to look at FCS operational and tactical air mobility requirements and feasibility. This project is still a very interesting project, but information and support from TRADOC was limited. We therefore shifted to conduct a dynamic systems requirements analysis on the high speed hypersonic interceptor (HSHI).

This new technology has the potential to fly at speeds of up to MACH 12 and has use as a ballistic missile interceptor. However, our exploratory work has led us to believe that this technology has potential high payoff Army application for our future force, as well. The primary Army value for this system would be in attacking time sensitive targets (TST) and an alternate use would be to use this technology for high speed intelligence gathering. A short list of these TST consists of tactical ballistic missiles, cruise missiles, high priority enemy personnel, and enemy hypersonic vehicles. Thus, once identifying the capability need and gap we conduct a comprehensive assessment of the integrated list of requirements associated employment, operation, training & education, sustainability, production, cost, and development lifecycle acquisition of the system. We have been successful at incorporating this aspect of the project as a cadet capstone yearlong project.

**Milestones:**

Integration of dynamic requirements modeling tool into Institute  
3QFY04

Development of Acquisition Systems Management Course  
3QFY04

Literature review on HSHI concept  
3QFY04

Conduct Concept Mission Analysis  
3QFY04

Identify Concept requirements  
3QFY04

Complete engineering management plan  
4QFY04

Hierarchical development of HSHI requirements flowing from the concept's mission analysis  
3QFY04

Identification of relational interactions of the concept's requirements  
1QFY05

Project IPR with proponent (review requirements and their relations)  
1QFY05

Development of Interchange SE relational database model  
1QFY05

Project IPR with proponent  
2QFY05

Functional decomposition modeling  
2QFY05

Project IPR with proponent  
3QFY05

NCO Information flow and control modeling  
3QFY05

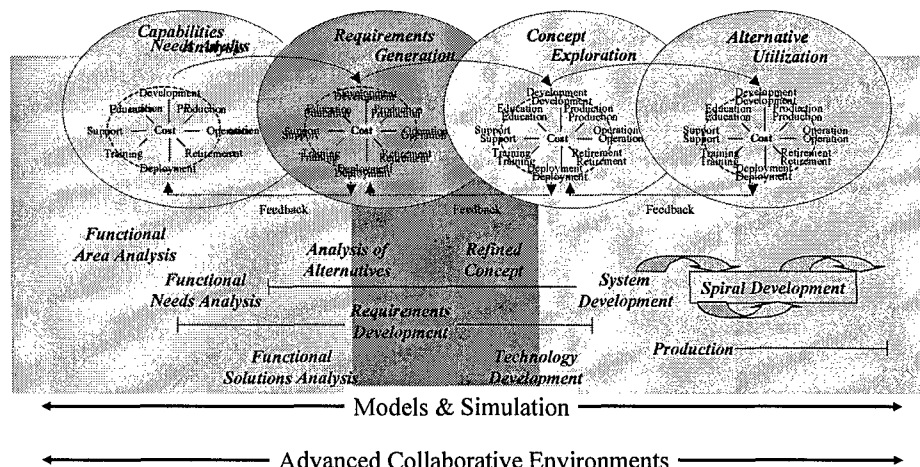
Project IPR with proponent  
4QFY05

Concept Specifications Modeling  
4QFY05

Analysis of Dynamic Modeling  
1QFY06

**Status of Work Completed:** But to fully conduct acquisition lifecycle management, we needed to develop concepts, methodology and classes that would support our ability to do research, and as importantly educate our cadets and faculty. The 1<sup>st</sup> effort was to develop a sound methodology for conducting lifecycle acquisition research that could be taught at the undergraduate level. This methodology is grounded in the DoD 5000 series documents, incorporates the Joint Capability Integration Development System (JCIDS), and uses modeling and simulation (M&S) and advanced collaborative environments (ACE). Figure 3 presents a holistic methodological perspective of conducting lifecycle acquisition management. Four major elements emerge from an introspection of these acquisition life cycle systems. The first is the need or capability gap that must be resolved for the force. The capability is the rough identification that a problem exists and this problem is of significant importance that a solution to the problem is required. The second emergent element is the requirement generation and problem restatement. In this phase, the requirement is developed, analyzed, evaluated, and refined. Here is where the feasibility of the requirement is vetted, current and future capabilities are determined, concept of exploration is planned, and ultimately the problem is restated to fit in the realm of the possible. Concept exploration is the next element. This phase compares the competing alternatives against established criteria, ultimately resulting in a determination of a particular alternative. The last phase is the utilization of the alternative. In this phase the alternative is put into operation for a period of time then retired. These four phases are integrally linked and allow for feedback between phases. Likewise, a continuing comprehensive analysis of the critical components essential to the acquisition process life cycle must be inherent within each phase and support the transition between phases. This methodology employs M&S and data and information sharing throughout the acquisition process. Both are critical elements

of acquisition systems management creating alternative use technology, fomenting knowledge creation, and developing information storage and transfer technologies. Thus, this methodological strategy provides a systematic understanding of the acquisition process, which is consistent with our current milestone decision process.



**Figure 3 Lifecycle Acquisition Management Methodology**

As our forces rely more heavily on sensors, computers, and other information technology to provide commanders with a clearer and more accurate picture of the battlefield, a key element to an improved picture of the battlefield is the proliferation of computer-enhanced systems that have greatly improved information processing and dissemination. Our military leadership is dedicated to seamlessly integrating these technology systems into a changing force structure and operational perspective. The combination of information operations, systems of systems, and integrated joint force operations will be commonplace in our future force. This requires that our acquisition methodology be modified to accommodate new research methods and tools to enable decision-makers to meet future force requirements and capabilities. Consequently, acquisition issues concerning interoperability, training, education, research and development, production, testing, operation, and support must be factored into the lifecycle development of a system from the origin of the need to its retirement from the force. This necessitates that the acquisition community refine acquisition procedures and processes that develop systems which are interoperable with other systems and integrated into our force structures and cultures, thereby, maximizing system capabilities and increasing strategic, operational, and tactical force performance. A key to realizing our transformation is the acquisition community's ability to incorporate models and simulation (M&S) into all phases of the acquisition process to verify and validate mission needs, requirements, concept exploration, alternative selection and procurement of systems.

To further instantiate an integrated lifecycle acquisition management methodology, we are developing a course in acquisition systems management with the Department of Systems Engineering. The Institute initially stemmed from the need to provide early acquisition education to cadets at the United States Military Academy in support of the Department of the Army's Simulation and Modeling for Acquisition Requirements and Training (SMART) initiative. A course for cadets in acquisition systems management is currently being designed to foster an early perspective and critical thinking regarding the acquisition process and M&S integration throughout the acquisition lifecycle. The basic tenets of the course (Figure 4) in acquisition management have already been developed and the first course is scheduled to be taught to the West Point class of 2005 in the spring semester of 2005.

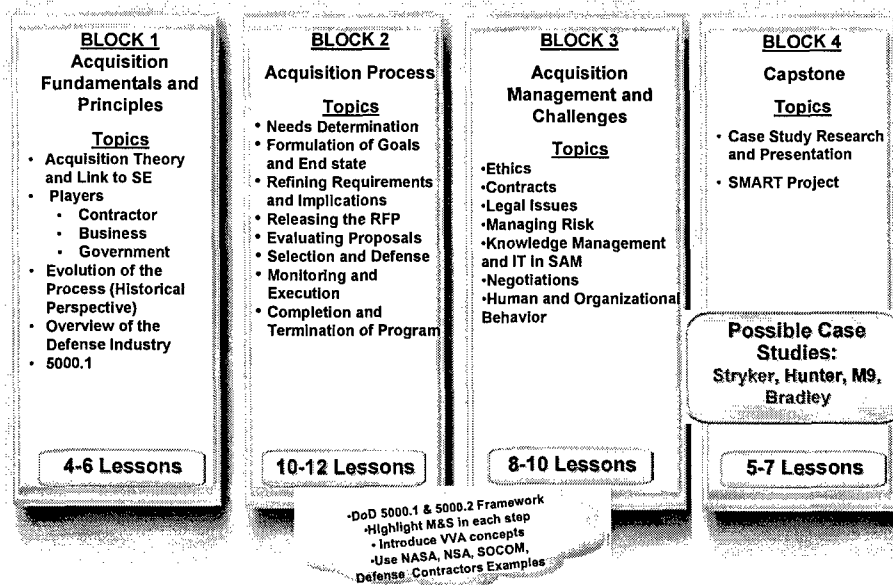


Figure 4 EM421 Acquisition Systems Management Course

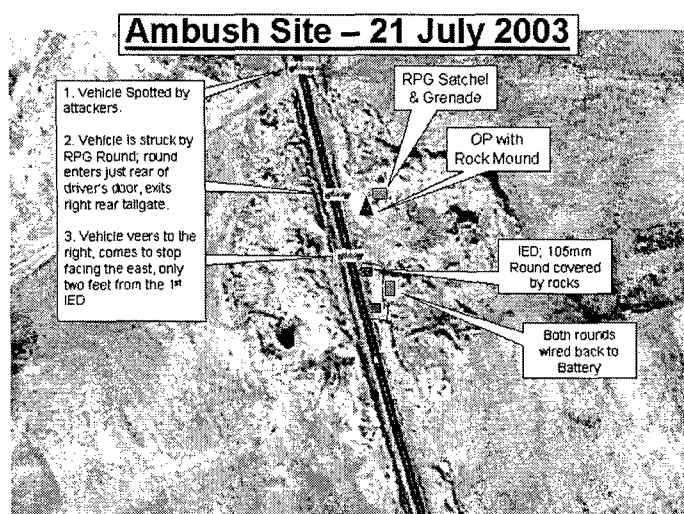
The infusion of new technology, process and doctrine portends to be part of the future force. The many white coats that support our operations in OIF and OEF are embedded with the military in substantially larger numbers than in Desert Storm. As we shorten the acquisition time for fielding a system or doctrinal change, we must take into account the management plan necessary to incorporate new upgrades and changes into the UA. Close coordination with the warfighter, material developer, program manager, throughout the process is critical to a successful fielding and employment of the newly upgraded system. Educating our officers on the acquisition process is important to there believe and working with the system. Software tools, hardware, and methodology that we have bought and developed will enable us to educate our faculty and cadets to this necessary warfighting support function.

This project work unit is going very well and is currently on track using the HSHI as the target system.

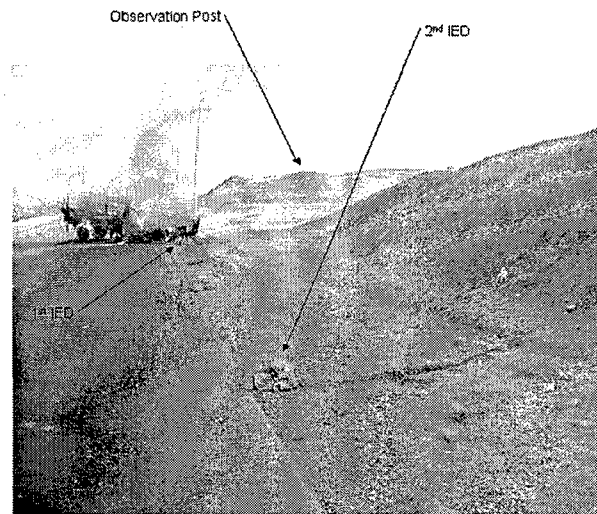
**Issues to Report:** None

### 3. Asymmetric Threat Detection and Defeat (ATD2) *New Start (FY05)*

**Problem Statement:** It is well established that Improvised Explosive Devices (IEDs) and other asymmetric threats are being employed effectively by opposing forces against U.S. and Coalition Troops in Iraq. The IEDs are relatively inexpensive to build and place in strategic locations, blending in reasonably well with surroundings. This facilitates the ability to set up ambushes and create diversions favorable to the enemy. Figures 5 and 6 below show events in Iraq where IEDs were used in an ambush against friendly forces. Employment of these unconventional methods creates a climate where the troops must be on the lookout for such devices and must be able to discern the enemy intent behind them, given they exist. There is a need to assist troops in the ability to rapidly and effectively detect and identify threats such as IEDs in the environment as part of creating effective tactics, techniques, and procedures (TTPs) to counter asymmetric threats. Furthermore, this capability supports the need to develop new military capabilities to allow our forces to achieve decisive advantage and to counterbalance asymmetric threats, particularly in urban operations (Draft Concept Paper, Joint Urban Operations, 13 Jan 04, JFCOM).



**Figure 5. Layout of Actual Ambush Site in Iraq**



**Figure 6. Photograph of ambush site with IEDs**

**Project Description:** The objective of this research is to illuminate key factors in identification of asymmetric threats to include IEDs to assist in effective defeat of these threats and TTP development. The approach will consist of the following tasks:

- (a) Perform a literature review to identify relevant work in this area of IED and asymmetric threat detection.
- (b) Work with the military community to select a set of pertinent asymmetric threats to assess and to determine a portfolio of vignettes representative of real-world situations that might be encountered
- (c) Research technologies to determine how to provide appropriate virtual environments for experiments simulating situations in which threats are/are not present. This will include advanced virtual environments to generate 3D immersive vignettes.
- (d) Employ advanced virtual environments and models and simulations to generate 3D immersive vignettes and conduct pilot tests to assess feasibility for this experimentation
- (e) Based on results of above, make appropriate modifications
- (f) Develop a reusable component suite of algorithms and tools for composing the simulated environments. This will include producing means for representing underlying physics-based or effects-based representation of systems and interactions.
- (g) Identify subject matter experts to participate in experiments.

- (h) Design and run a series of experiments to surface key factors in identification of threats and related to the Military Decision Making Process (MDMP) regarding enemy course of action analysis to assist in TTP generation.
- (i) Perform statistical analysis to identify key factors after various phases of experimentation above.
- (j) Provide recommendations regarding TTP generation and potential technologies that could be applied for defeat of asymmetric threats.

Technology transfer will occur through several mechanisms, including recommendations to the community regarding TTPs and technologies with potential against asymmetric threats; algorithms, tools, and procedures for illumination of factors in identifying asymmetric threats and for assessing associated technologies; presentations and reports.

#### **Milestones:**

Select set of pertinent asymmetric threats to assess	Q1 FY05
Assess/identify simulation environments for select asymmetric threat experiments FY05	Q2
Conduct pilot studies to bound experiments FY05	Q3
Conduct phase I experiments for asymmetric threat assessment FY05	Q4
Revise set of asymmetric threats as needed FY06	Q1
Design reusable component suite concept and begin to populate	Q2 FY06
Conduct phase II experiments with a focus on materiel technologies insertion FY06	Q3
Conduct statistical analysis and vet recommendations FY06	Q4
Revise set of asymmetric threats based on current operational needs FY07	Q1
Identify relevant materiel solutions to assess for threat detection/defeat FY07	Q1
Develop/adapt algorithms for component suite additions for phase III experiments FY07	Q3



Conduct phase III experiments Q4  
FY07

Complete analysis and recommendations for TTPs associated with Q4  
experiments  
FY07

**Progress to Date:** None. This is a new start for FY05.

#### 4. Information Visualization

**Problem Statement:** Most organizations consistently use 2D flat files to portray information. Information displayed in this fashion has served our organizational processes well up to this point. However, limited the display of our information in this way removes a third dimension that our minds are accustomed to perceiving. With the emergence of 3D graphics and displays it has become more assessable for organizations to display information in a 3D or immersive environment.

**Project Description:** This project will attempt to translate relational object oriented databases into 3D immersive environments that can be manipulated by a consumer of that information.

##### **Milestones:**

Database management system development  
3QFY04

Engineering management plan development  
4QFY04

Identification of 3D and/or immersive software  
4QFY04

Begin development of 3D objects and immersive environment textures  
4QFY04

IPR to proponent and coordination with DARPA Visualization Program  
4QFY04

Development of multiple 3D objects and immersive environment textures 1-  
4QFY05

Migration of one 2D personnel database elements into 3D objects  
2QFY05

Incorporation of immersive environments within 3D objects  
2QFY05

Project IPR with proponent  
2QFY05

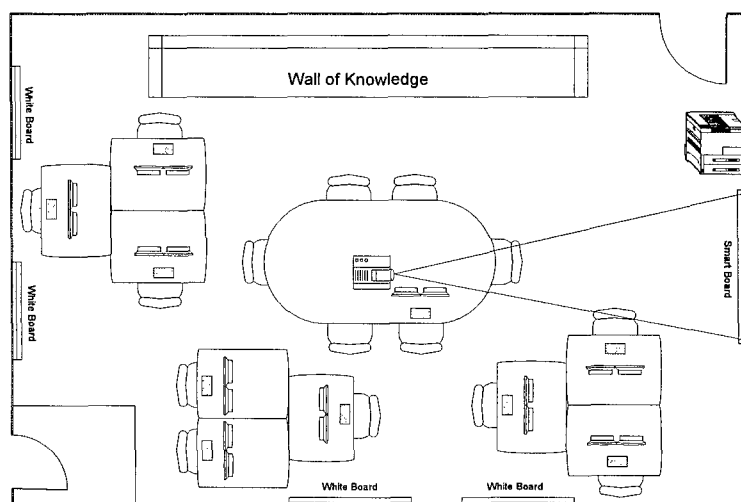
Migration of entire 2D database to 3D and immersive environments	
4QFY05	
Project IPR with proponent	
4QFY05	
Development of multiple 3D objects and immersive environment textures	1-
4QFY06	
Design of experiment	
1QFY06	
Information visualization experiment #1	
1QFY06	
Analysis of experiment #1	
2QFY06	
Information visualization experiment #2	
2QFY06	
Analysis of experiment #2	
3QFY06	
Analysis of results and findings	
4QFY06	

**Status of Work Completed:** We are all aware of the requisite need for information dominance to support the overarching success of the future force. The timely, quality, veracity, and type of information will inform the decisions and actions of our future warfighting force in a manner that has been unprecedented in our military history. The media, delivery, integrative nature, and timing of the information packets that will drive decision makers, has yet to be fully explored.

Our research into this area is taking shape in the LAM Institute's ability to visualize information in more holistic manners, using integrated distributed sources, and combining multiple media types. Our AMSD Lab provides the capability to view not only text information, but more importantly simulated virtual and constructive 2D and 3D information dynamically. It also provides the capability for decision makers, data gathers and data creators to view and analyze the data and information collectively. Our efforts have expanded to provide a more robust learning and research environment where our cadets and faculty can display and analyze disparate pieces of information at one time. This has been made possible through the procurement of a wall of knowledge capability, much like the AEGIS ship system. With the plethora of information at each major command level it becomes a necessity to educate our cadets and officers how to gather, synthesize, display, and analyze the many sources and type of information that will be fed to them daily. The capability we are developing will allow faculty, cadets, and professionals from all disciplines to learn how to manage information so it is better able to inform decision and action. Our concept is to develop an Information Visualization lab (Figure 7) to facilitate this learning.

The center piece of this effort is the Wall of Knowledge. The Wall of Knowledge is a large screen, high resolution display technology for data and information imaging. The screen size is modular allowing for independent projections of information from 10 separate projects to one continuous projection. The wall projection size is 3' x 6'5" x 13'8". The IV lab represents an integrated engineering environment for consolidated architectural review and dynamic information visualization. As mentioned above the system has the capability to incorporate information feeds from up to ten computer systems at one time and display the information in user-defined, varying configurations. This will enhance the collaborative environment concepts taught in our academic disciplines and research at the Academy.

We are currently waiting for the contractor to install the Wall of Knowledge, and we have prepared the lab space to receive the technology. The work on this project is progressing smoothly and we anticipate gathering data to measure the information visualization effect, as well as expose our faculty and cadets to the potential technologies they will employ in the future.



**Figure 7 IV Lab**

**Issues to Report:** None

**5. Knowledge Management; 6. System Prototyping; and 7. Policy and Trade Space Analysis** are research areas we are preparing to do, but have not launched specific projects. We are preparing our facilities to work projects in these areas to support the UA and future force.

**Project Status:** Continuing. The LAM project is funded through FY07. The USMA research team is committed to completing its work and providing a robust acquisition research environment for investigation of UA technologies and operations.

Any questions or comments can be sent to LTC Willie McFadden, 845-938-5941, Dr. Paul West, 845-938-5871, or Dr. Niki Georger, 845-446-3180.

## ***Afghanistan National Development Assessment System (ANDAS)***

**DSE Project No: DSE-R-0425**

**Client Organization:** Combined Joint Task Force – 180 (CJTF-180)

**Faculty Analyst:** Lt Col Edward A. Pohl, Ph. D., Dr. Richard Deckro, Ph.D.,  
MAJ John Brence, M.S., MAJ Mark Gorak, M.S.,  
MAJ John Morel, M.S., CPT Eric Tollefson, M.S.,  
**Senior Investigator:** LTC Michael J. Kwinn, Jr., Ph.D.,  
COL Daniel Ragsdale, Ph. D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
BG Byron Bagby, Director, CJTF-180 Staff	Bagram Air Base, Afghanistan		
Major Gus Kostas, Chief, Assessment Group, CJIS	Bagram Air Base, Afghanistan		

### **Problem Description:**

Very early on in Operation Enduring Freedom in Afghanistan, the command group recognized the need for a comprehensive assessment support system to provide the command with a means to direct future operations and effects and to allow for reporting to CENTCOM on the current status of the operation. They requested the support of the Information Technology and Operations Center (ITOC) at the United States Military Academy at West Point to travel to Afghanistan and develop a web-based, distributed system to provide the command with this assessment capability.

The ITOC developed a system which they dubbed the Dynamic Planning and Assessment Support System, or D-PASS. At the request of the command, this system provided a subjective means to assess tasks and objectives which supported the overall operation. For the initial phases of the operation, this system achieved all the objectives set out by the command.

During subsequent operations and with a new command unit in place, it became increasing apparent that this system did not provide the assessment capability now required by the command. Specifically, the command required a system based on more qualitative assessments of the operation. To develop such a system, the command requested the support of the Operations Research Center of Excellence (ORCEN). They still wanted the system to be web-based and distributed, which led to a collaborative effort between the ORCEN and the ITOC.

**Proposed Work:**

Analysts from the ORCEN, augmented by a senior analyst from the Air Force Institute of Technology (AFIT), will depart to Afghanistan to analyze the needs and requirements of the system to be developed. Upon development of the more quantitative system, the ORCEN and the ITOC will collaborate in the implementation of the system into the web-based, distributed environment found in D-PASS.

Analysts from both Centers of Excellence will then return to Afghanistan to provide the new assessment system to the command. This new system will be called the Afghanistan National Development Assessment System, or ANDAS.

**Results Summary:**

In this report, we discuss an assessment methodology developed to assist in determining whether we are winning or losing the global war of terror in Operation Enduring Freedom. The assessment system developed is based on metrics and was developed with the support of the Operational level staff in Afghanistan.

From the start of the operation, the Combined Joint Task Force – 180 in Afghanistan needed a methodology to assess their current situation. The system had to provide them with a means to convey their status to higher levels of command and support decisions on future necessary effects required by subordinates. In late 2002, the command asked a group from the Information Technology Operations Center (ITOC) from the US Military Academy to develop a system to assist in this process.

At that time, the command wanted a system that allowed a great deal of subjective assessments and only loosely based on quantitative analysis. To support this, the ITOC developed a system called the Dynamic Planning and Assessment System, or DPASS. This web-based system decomposed the effects the command was asked to attain by the CENTCOM CONOP. The system was very useful for the command at the time.

In spring of 2003, Mr. Donald Rumsfeld announced that Afghanistan had entered Phase IV, or Stability Operations. This new mission set coincided with the arrival of a new command group in CJTF-180. They immediately sought a system based directly on metrics. The command staff could not adjust DPASS to directly account for these and they decided to ask the Operations Research Center of Excellence (ORCEN) also at the US Military Academy to look at the problem for them.

The ORCEN analysts, in consultation with the previous ITOC analysts and the CJTF-180 Assessment Staff, determined that a major obstacle in the development of a quantitative means to assess the implementation of the effects-based orders was the “task-based” approach to decomposition. Our functional decomposition, the identification of direct metrics and the application of value focused thinking to the assessment process are discussed in this presentation and paper. Additionally,

the model developed and now being implemented in CJTF-180 will be discussed in detail. The model, the Afghanistan National Development Assessment System, or ANDAS, achieves Secretary Rumsfeld's goal of being able to use metrics to assess our level of success as well as provides the CJTF-180 staff with a means to identify on which effects they should focus their efforts in future operations.

#### **Requirements and Milestones:**

- Early August 2003: ORCEN team arrives for initial visit to Afghanistan to assess system requirements and conduct initial model development - *Complete*
- Early September 2003: ORCEN team returns to West Point to complete system and begin collaboration effort with ITOC - *Complete*.
- Early October 2003: ORCEN team returns to Afghanistan to present proposed model to command. ITOC continues development of web-based, distributed system incorporating new model - *Complete*
- January 2004 – Analysts from ORCEN and ITOC return to Afghanistan to present final model to command - *Complete*

#### **Project Deliverables and Due Date:**

- IPR 1 – Initial Problem Statement, August 2003 - *Complete*
- IPR 2 – Initial Model Development, August 2003 - *Complete*
- IPR 3 – Completed Model Development, October 2003 - *Complete*
- Final Briefing: Final Model, January 2004 - *Complete*
- Technical Report: February 2004 - *Complete*

#### **Publications and Presentations:**

- Kwinn, M. J., Jr., Ragsdale, D. J., Brence, J., Morel, T., Pohl, E. A., Goldman, S., Tollefson, E. S., Gorak, M., Deckro, R. F., Carver, C. A., 2004, "Operation Enduring Freedom Assessment System Development," in the Proceedings of the Defense Analysis Seminar XII, Seoul, Korea.
- Kwinn, M. J., Pohl, E. A., Deckro, R., F., "Combat Consultants", Phalanx, pp. 10-11, 30, Vol 36, No. 4, December 2003.
- Kwinn, M. J., Pohl, E., Deckro, R., and Ragsdale, D., "Using Quantitative Means to Measure Success and Identify Directions in Effects Based Operations", Presentation for the Military Operations Research Society Symposium, June 2004.

- Kwinn, M. J., Brence, J., Morel, T., Pohl, E., and Deckro, R., "Assessment in Afghanistan using Value Focused Thinking", Presentation for the Military Operations Research Society Symposium, June 2004.
- Kwinn, M. J., Edward A. Pohl, Richard, Deckro, Gus Kostas, John Brence, Mark Gorak, Eric Tollefson, "Afghanistan National Development Assessment System (ANDAS)", US/GE Operations Research Symposium, 5 Nov 2003.
- Kwinn, M. J., Pohl, E. A., Deckro, R. F., "CJTF 180 Assessment Analysis", presented to MG(P) Barno, Commander, Combined Forces Command – Afghanistan, Oct 2003.



## ***Analysis of the Research and Studies Program at the United States Military Academy***

**DSE Project No: DSE-R-0426**

**Client Organization:** USMA – Office of the Dean of the Academic Board, West Point

**Research Team Lead:** LTC Michael J. Kwinn, Jr., Ph.D.  
**Research Team:** COL Barry Shoop, Ph.D., COL Darrall Henderson, Ph.D.,  
LTC Robert Hansen, Ph.D., LTC Kenneth McDonald, Ph.D.,  
MAJ Andrew Koloski, M.S., 2LT Ryan Kent, B.S.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
BG Daniel Kaufman, Ph.D. Professor & Dean of the Academic Board	United States Military Academy Thayer Hall – Bldg #600 West Point, New York 10990	845-938-2000	Daniel.kaufman@usma.edu
COL George (Barney) Forsythe, Ph.D. Professor & Vice Dean for Education	United States Military Academy Thayer Hall – Bldg #600 West Point, New York 10990	845-938-3615	Barney.forsythe@usma.edu
Dr. Kenneth Grice, Ph.D. Professor & Vice Dean for Resources	United States Military Academy Thayer Hall – Bldg #600 West Point, New York 10990	845-938-5007	Kenneth.grice@usma.edu

### **Problem Description:**

**Background:** The amount of time and effort devoted to research by the faculty at the United States Military Academy has been increasing over the past 20 years. Commensurately, the funding received by the departments and the research centers of excellence has grown dramatically. There are two significant complementary forces driving these increases:

1. More departments and faculty researchers are understanding the significantly positive value of conducting research on Army and DoD projects and its impact on their teaching cadets in the classroom, and
2. More organizations are aware of the impact US Military Academy researchers can have on their organization through the application of their analytical abilities combined with their military expertise.

The Dean of the Academic Board, BG Daniel Kaufman, wants to ensure that the outreach research program continues to grow by enabling researchers and facilitating their interaction with clients. Conversely, he also wants to ensure the research continues to improve the educational experience in the classroom and does not become its detriment.

**Proposed Work:**

To accomplish this task, BG Kaufman, requested the Department of Systems Engineering lead a team of analysts to determine the organization and approach required to meet the Academy's needs.

The way ahead included:

- Stakeholder analysis through interviews with all Department Heads and Directors of the USMA Centers of Excellence, and other key personnel
- Application of the Systems Engineering Process (SEP) to develop recommendations.
- Development of a Plan for Implementation.

**Results Summary:**

The final recommended course of action which address the Dean's and other significant stakeholders needs, wants and desires is for the Academy to increase the size – and impact – of the Academic Research Division (ARD) and institute a Research Advisory Council to facilitate interdisciplinary interactions between departments and research centers.

**Requirements/Milestones/Deliverables:**

- |   |                      |
|---|----------------------|
| • Initial IRP to Dean                     | December 2003        |
| • Interim IPR to Dean                     | February, April 2004 |
| • Implementation Briefing to Dean         | May 2004             |
| • Recommendations and Implementation Plan | May/June 2004        |
| • Final Written Report                    | Sept 2004            |

**Presentations and Publications:**

- LTC Michael J. Kwinn, Jr., Ph.D. et.al., *Analysis of the Research and Studies Program at the United States Military Academy*, Operations Research Center of Excellence, Technical Report No. DSE-TR-0426, September 2004.

**Personnel Briefed:**

- BG Daniel J. Kaufman, Ph.D., Professor and Dean of the Academic Board, USMA, West Point.

- Dean's Review Board – COL G. Barney Forsythe, Ph.D., Professor and Vice Dean for Education, USMA, West Point, Dr. Kenneth Grice, Ph.D., Professor and Vice Dean for Resources, USMA, West Point.

## ***U.S. Army Delayed Entry Program Optimization Model***

**DSE Project No: DSE-R-0428**

**Client Organization:** United States Army Recruiting Command's (USAREC),  
Ft. Knox, KY

**Principal Analyst:** CPT Jason Wolter, M.S.

**Senior Investigator:** LTC Michael J. Kwinn, Jr., Ph.D

### **Point of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
Vincent Orouke (client)	HQ USAREC Attn: RCPAE (MAJ O'Rourke) Bldg. 1307 Fort Knox, KY 40121	(502) 626-1872	Vincent.Orouke@usarec.army.mil

### **Problem Description:**

To better support the growing and transforming Army, USAREC continues to examine ways to improve recruiting efficiency and quality. The focus of this research was to identify proper inventory levels for new recruits throughout the accession process. Traditionally, young men and women are contacted by recruiters who worked hard to show possible candidates the benefits and opportunities in the service. Those candidates who are eligible and desire to serve in the Army are contracted. Once a recruit is contracted, they may wait up to twelve months in a Delayed Entry Program (DEP) before departing for service. In this research we examined the appropriate level of new recruits that should enter into basic training during the same month they are contracted. These recruits are labeled "In and For" recruits and present a particular challenge to USAREC. The second area of our research is properly identifying the percentage of recruits that should be contracted in the current year for accession in the following year. This surplus of recruits helps to reduce the seasonality in recruiting and helps to achieve annual recruiting missions.

### **Proposed Work:**

- Research and Evaluate past DoD recruiting models
- Try to integrate previous research concepts to include the use of binary integer goal programming in determining Army enlistment initiatives.

- Create a program that enhances the efficiency of school planning, and provides better long-range planning resolution.

### **Results Summary:**

This research examined two critical pieces of the recruiting process for USAREC. The first area of study was identifying the correct number of candidates that should be recruited and shipped to training the same month, also known as "In and Fors". We recommend the optimal "In and For" level should be set to zero to reduce initial entry attrition rates. Recent changes in the world environment and the Army's transformation process affected the recommendation for a minimized "In and For" level. First, as part of the transformation the Army Chief of Staff Gen. Peter Schoomaker is adding 30,000 troops to the payrolls through fiscal year 2007. At the current DEP loss rates the addition of 30,000 new recruits may cost the Army over \$90 million in DEP loss alone. Previous studies and this research concur with General Cavin's beliefs that prequalifying our young soldiers, whether it is the physical fitness assessment or the indoctrination of the warrior ethos during the preparatory training in the Delayed Entry Program is one of the biggest payoffs that have come from linking the Recruiting Command with the training bases. Additionally, increased training in the Delayed Entry Program will reduce overall basic training attrition rates by more than three percent by the end of 2005. Increasing the robustness of the DEP program coupled with a minimized "In and For" level will provide the force with capable soldiers while saving the organization's resources.

The second portion of this research was accurately modeling the necessary size of the entry DEP (EDEP). The EDEP size is driven by Department of the Army's projections for the next year total accession requirements. This EDEP, usually 35% of next year's expected mission, represents the number of contracts that must be produced in the current year with a planned accession date in the following year. A number of alternatives were evaluated to solve this problem including Bayesian Belief Networks, dynamic programming and linear programming. This research was successful in creating an Excel based linear program that optimized the number of recruits by type. After evaluating the model, we believe that an optimum EDEP does not exist; it is based on the current strategy set by the Commanding General of USAREC for quality versus quantity, the countries economic state, and other environmental variables. Determining a raw number through optimization, DP, or other method does not account for the dynamic nature of recruiting and is inherently wrong. Efforts to model and identify a specific annual EDEP value for USAREC do not encompass the intricacies or dynamic nature of the recruiting environment.

We believe that further research in this area should involve creating a missioning model simulation that tracks the process from first contact on daily basis from all recruiting battalions to the recruit's shipment to training. A simulation model would assist USAREC in determining the optimal flow of production given set economic and environmental variables. This would allow for multiple scenarios, course of action war gaming and ultimately the ability to recommend policy.

**Requirements and Milestones:**

- *Initial Familiarization and Planning Trip-Ft. Knox (Spring 04)*
- *Proposed Study Plan & Literature Search documented (Spring 04) - **completed***
- *Literature Search complete and documented (Spring 04) – **completed***
- *Description of proposed database and software (Spring 04) – **completed***

**Project Deliverables and Due Date:**

- Decision support product - **completed**
- Technical Report - **completed**
- Policy recommendations on DEP efficiency and effectiveness - **completed**
- Brief to USAREC technical staff with demonstration - **NA**

**Presentations and Publications:**

- Wolter, Jason A., Kwinn, Michael J. Jr., Ph.D., Brence, John R., Ph.D., A White Paper Summary: *An Overview of Research Conducted on the DoD's Delayed Entry Program (DEP)*, Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 2 April 2004.
- Wolter, Jason A., Kwinn, Michael J. Jr., Ph.D., Brence, John R., Ph.D., An Analysis of an Optimization Management System for the Delayed Entry Program (DEP). 72nd MORS Symposium, 22-24 June 2004, Naval Postgraduate School.
- Wolter, Jason, Kwinn, Michael Jr. PhD, *U.S. Army Delayed Entry Program Optimization Model*, Operations Research Center of Excellence, Technical Report DSE-TR-0428, November 2004.

**Personnel Briefed:**

- MAJ Vincent J. O'rouke (Market Analyst, USAREC)
- LTC Michael J. Kwinn Jr., PhD (ORCEN Director)

**Status:** Complete.

## ***Transforming the Department: 1999-2004***

**DSE Project No: DSE-R-0429**

**Client Organization:** Department of Systems Engineering and Office of the Dean, US Military Academy, West Point, New York.

**Senior Investigator:** COL Michael L. McGinnis, Ph.D.

### **Points of Contact:**

<b>NAME:</b>	<b>ADDRESS:</b>	<b>PHONE:</b>	<b>OTHER:</b>
Colonel Mike McGinnis	Department Chair Department of Systems Engineering US Military Academy West Point, NY 10996	845-938-2701	systemsix@netzero.com

### **Problem Description:**

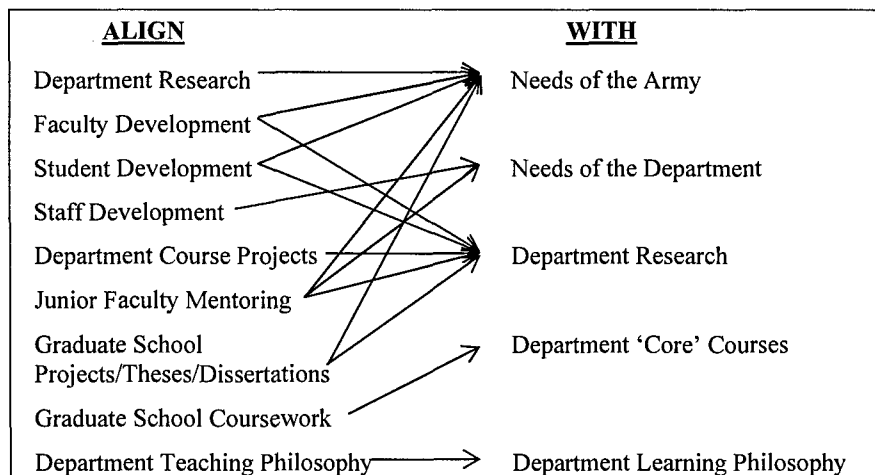
Established in 1989, the Department of Systems Engineering at the United States Military Academy, West Point, New York offers pedagogically sound, ABET accredited undergraduate degrees in systems engineering and engineering management. However, from the start, course development, teaching, student summer internships, faculty research, and faculty development were essentially managed as separate, individual-centric, stove-piped programs. In the summer of 1999, an internal Department 'review and assessment' by senior faculty identified this as a major hindrance to the Department's pursuit of excellence and higher performance. In an effort to improve performance and efficiency across all programs, the Department leadership developed a plan to transform the department by better aligning and enhancing the synergy between programs. This report discusses the challenges of this undertaking and highlights the success of our continuing transformation process.

### **Proposed Work:**

- Document the changes to the Department of Systems Engineering during the period from June 1999 through June 2004
- Document the process of change for transforming the Department
- Create a useful list of lessons learned for government and academic organizations undergoing change

### Results Summary:

This report documents a five year transformation of the Department of Systems Engineering at West Point from a stove-piped organization into a flat, robust matrix organization. The process of change was driven by (1) a commitment to excellence in all areas; and (2) to generating synergy and efficiency among programs through alignment. This study builds on previous efforts from 1989 through 1999 to stand up the Department. The Department's programs that were aligned included cadet and faculty development, funding, research, communications, academic promotions, graduate school for incoming faculty, teaching and curriculum development. Alignments are depicted in the figure below.



### Requirements and Milestones:

- Program Improvements and Alignments (Fall 99 through Summer 04) **Complete**
- Design, fund and implement a System Engineering and Management Laboratory to support Department research and teaching (Fall 99 through Summer 04) **Complete**
- Design, fund and implement a knowledge and information management system for the Department (Spring 05) **Continuing, work-in-progress.**

### Presentations and Publications:

- Kwinn, M. J., E.A. Pohl, M.L. McGinnis, W.B. Carlton. 2002. "Capstone Design in Education: Systems Engineering and the West Point Way," *Proceedings of the 12th Annual International Symposium of the International Council on Systems Engineering (INCOSE)*, Las Vegas, Nevada.



- McCarthy, D.J., W.J. McFadden, M.L. McGinnis. 2003. "Put Me in Coach I'm Ready to Play!: A Discussion of an Evolving Curriculum in Systems Engineering" in *Proc. of the International Council of Systems Engineering (INCOSE)*, Washington, D.C.
- McGinnis, M.L., M.J. Kwinn, E.A. Pohl, D.J. McCarthy. 2004. "Building a Team-focused Academic Department: Creating Synergy through Alignment of Programs and Education Outcome Goals" in *Proc. of the Hawaii International Conference on Education*, Honolulu, HI.
- Pohl, Lt Col (Ret) Edward A., Ph.D., Colonel Mike McGinnis, Ph.D., Col (Ret) Gregory Parnell, Ph.D., Lt Col Michael Kwinn, Ph.D., Lt Col Willie McFadden, Ph.D., Major Daniel McCarthy. 2004. "Meeting the Needs of the Customer: Systems Engineering at the United States Military Academy," to appear in *Proc. for the International Conference on Systems Engineering*, Las Vegas, NV.

**Personnel Briefed:**

- BG Fletch Lambkin, former Dean of the Academic Board, USMA
- BG Dan Kaufman, Dean of the Academic Board, USMA
- Board of Advisors, Department of Systems Engineering, USMA
- Dr. Donald Brown, Department of Systems and Information Engineering, UVA

**Status:** Work will continue for the next several years to finish major tasks and activities such as completion of the Systems Engineering and Management Laboratory and completion of the knowledge architecture and enterprise initiative.

***Operation Scavenger: Standing Up a Deployable Joint Headquarters for the NATO Response Force***

**DSE Project No: DSE-R-0430**

**Client Organization:** US ADM Gregory G. Johnson, CIC, JFC, Naples, Italy  
and UK ADM Sir Ian Forbes, DSACT, Allied Command Transformation, Norfolk, Virginia.

**Senior Investigator:** COL Michael L. McGinnis, Ph.D., in collaboration with  
MG (P) Rick Lynch, ACSO, JFC, Naples, Italy.

**Points of Contact:**

NAME:	ADDRESS:	PHONE:	OTHER:
Colonel Mike McGinnis	Department Chair Department of Systems Engineering US Military Academy West Point, NY 10996	845-938-2701	systemsix@netzero.com

**Problem Description:**

In October, 2003, the North Atlantic Council stood up the NATO Response Force. When fully operational in the fall of 2006, the force will consist of 22,000 to 24,000 personnel from all services deployable within five days of alert and able to conduct "stand-alone" operations for 30 days. A deployable joint task force (DJTF) headquarters of approximately 90 personnel, commanded by a one or two star, will exercise operational-level command and control, and plan, coordinate and conduct effects-based operations. Lessons learned from training and experimentation with the new force from 2003 through certification in 2006 will serve as a catalyst for transforming NATO's Cold War-focused forces into a new force for accomplishing new missions ranging from humanitarian relief to forced entry into a hostile environment. This report discusses challenges encountered while simultaneously working through two systems and organizational engineering and design problems to stand up the DJTF headquarters: (1) transforming a traditional J-staff headquarters into a deployable joint headquarters capable of planning and assessing effects-based operations, and (2) putting effects-based operations concepts and theory into practice.

**Proposed Work:**

- Document the new NATO Response Force concept, capabilities and missions, and NRF command and control (C2) relationships. Review and document the literature on effects based operations

- Document and discuss the application of effects-based operations theory to the new headquarters during a deployment exercise to Scavenger, Norway.
- Formulate observations and lessons learned from initial steps taken to stand up NATO's first deployable, operational-level, joint task force headquarters at Joint Forces Command Naples

### **Results Summary:**

This report discusses challenges encountered while simultaneously working through two systems and organizational engineering and design problems to stand up the DJTF headquarters: (1) transforming a traditional J-staff headquarters into a deployable joint headquarters capable of planning and assessing effects-based operations, and (2) putting effects-based operations concepts and theory into practice. The report begins with an overview of the new NATO Response Force concept, capabilities and missions, and NRF command and control (C2) relationships. Next, the report discusses the application of effects-based operations theory to the new headquarters during a deployment exercise to Scavenger, Norway. Observations and lessons learned from initial steps taken to stand up NATO's first deployable, operational-level, joint task force headquarters at Joint Forces Command Naples are provided. We conclude with the way ahead.

### **Requirements and Milestones:**

- Review and documentation of EBO Literature (Fall 03) *Complete*
- Develop methodology for applying EBO to a deployable joint headquarters at the operational level (January through February 04) *Complete*
- Design, fund and implement a knowledge and information management system for the Department (Spring 05) *Continuing, work-in-progress.*

### **Project Deliverables and Due Date:**

- Methodology for applying effects-based operations at the joint, operational level: February 2004.
- Architectures and Layouts for the Deployable Joint Task Force (DJTF) Headquarters, Naples, Italy: February through April 2004.
- Technical Report: June 2004.

### **Presentations and Publications:**

- McGinnis, M.L. and Major General (P) Rick Lynch. 2004. "An Innovative Application of Systems Engineering: Standing-up a Deployable Joint Headquarters for the NATO Response Force," in the *Proc. of the International Conference on Systems Engineering*, Las Vegas, NV.

- McGinnis, M.L. 2004. "Standing Up A New Deployable Joint Headquarters For The NATO Response Force. Submitted for review to Joint Force Quarterly, National Defense University, Fort Lesley J. McNair, Washington, D.C.

**Personnel Briefed:**

- Ninety members from 11 NATO nations assigned to the DJTF Headquarters
- Twenty flag officers and 120 senior members assigned to Joint Force Command Naples
- Discussions/Briefings with US Admiral Gregory G. Johnson, Commander in Chief, Joint Force Command Naples, Naples, Italy and UK Admiral Sir Ian Forbes, Deputy Supreme Allied Commander Transformation, Allied Command Transformation, Norfolk, Virginia.
- Operation Scavenger exercise senior mentor, US Marine Corps General (Ret.) Richard "Butch" Neal
- UK Army Major General James Short, Joint Warfighting Center Chief of Staff
- Norwegian Army Lieutenant General Thorstein Skiaker and US Air Force Major General Bill Lay II, JWC Director and Deputy Director, respectively

**Status:** Initial Technical Report is complete. The final report will include alternative headquarters layouts and a final set of observations and lessons learned from exercises Allied Action 2004 and Dynamic Action 2004.

## **PART VI - Faculty Activity, Academic Year 2003-2004**

(\* Indicates multiple department authors)

### **BLAND, WILLIAM, PH.D., LIEUTENANT COLONEL**

#### **Awards**

Barchi Prize Nominee for best presentation in Working Group 6 – C4ISR, at the 71<sup>st</sup> Military Operations Research Society Symposium (MORSS).

#### **Books and Book Chapters**

Bland, William S., *A Simulation-Based Approach for Efficient Sensor Management of Distributed Sensor Networks*, Dissertation, University of Virginia, Charlottesville, Virginia, 2003.

#### **Conference Presentations**

Bland, William S., "A Sensor Management Model Using Simulation-Based Approximate Dynamic Programming," Military Operations Research Society Symposium, United States Marine Corps, Quantico, VA, Jun 2003.

**Number of Refereed Journal Publications reviewed: 2**

### **BRENCE, JOHN R., PH.D., Major**

#### **Awards**

Finalist for the Military Operations Research Society's Richard H. Barchi Prize, 2004

#### **Refereed Journal Publications**

Brence, John R., Ph.D. and Mastrangelo, Christina M., Ph.D., Parameter Selection for a Robust Tracking Signal, Submitted to the Journal Quality and Reliability Engineering International, 2004.

#### **Refereed Conference Proceeding Publications**

Brence\*, John R., Kwinn\*, Michael J. Jr. Ph.D., Thomas, David A. Ph.D., Modeling for US Army Recruiter Allocation, Proceedings of The Institute of Industrial Engineers Annual Conference, Houston, TX, 15-19 MAY 2004.

#### **Non-Refereed Publications**

Brence\*, John R. Ph.D., Kwinn\*, Michael J. Jr. Ph.D., United States Army Recruiter Allocation Model, Operations Research Center of Excellence, Technical Report DSE-TR-04-03, July 2004.

Brence, John R. Ph.D., Recruiter Allocation Model Research Applicability to Classroom Instruction, Information Paper for D/SE and D/MATH. June 2004.

Brence\*, John R. Ph.D., Driscoll\*, Patrick J. Ph.D., Kwinn\*, Michael Jr. Ph.D., Modeling Corrosion using Non-destructive Test Data: An Application of

Robust Measures to Random Forest Regression, Operations Research Center of Excellence, Technical Report DSE-TR-04-01, May 2004.

Wolter\*, Jason A., Kwinn\*, Michael J. Jr., Ph.D., Brence\*, John R., Ph.D., A White Paper Summary: An Overview of Research Conducted on the DoD's Delayed Entry Program (DEP), Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 2 April 2004.

Kwinn\*, Michael J. Jr. Ph.D., Ragsdale, Daniel J. Ph.D., Brence\*, John R., Morel, Thomas, Pohl\*, Edward A. Ph.D., Goldman, Stephen, Tollefson\*, Eric, Gorak\*, Mark, Deckro, Richard F. Ph.D., Carver, Curtis A. Ph.D., Operation Enduring Freedom Assessment System Development, Defense Analysis Seminar XII, Seoul, Korea, 29 March – 1 April 2004.

Brence\*, John R., Kwinn\*, Michael J. Jr., Ph.D., Wolter\*, Jason A., A White Paper Summary: Recruiter Management Workshop, Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 30 March 2004.

#### **Conference Presentations**

Brence, John R. Ph.D., Kwinn, Michael J. Jr. Ph.D., Thomas, David A. Ph.D., Qualitative and Quantitative Analysis for U.S. Army Recruiting Input Allocation, 72nd Military Operations Research Society Symposium, Naval Postgraduate School, Monterey, California 22-24 June 2004. Selected as Best in Working Group 20 and Finalist for 2004 Barchi Prize.

Wolter, Jason A., Kwinn, Michael J. Jr., Ph.D., Brence, John R., Ph.D., An Analysis of an Optimization Management System for the Delayed Entry Program (DEP). 72nd MORS Symposium, 22-24 June 2004, Naval Postgraduate School.

Kwinn, M. J., Brence, J., Morel, T., Pohl, E., and Deckro, R., Assessment in Afghanistan using Value Focused Thinking, 72nd Military Operations Research Society Symposium, Naval Postgraduate School, Monterey, California 22-24 June 2004.

Kwinn, Michael J. Jr. Ph.D., Pohl, Edward A. Ph.D., Deckro, Richard F. Ph.D., Kostas, Gus, Brence, John R., Gorak, Mark, Tollefson, Eric, Afghanistan National Development Assessment System (ANDAS), US/GE Operations Research Symposium, German Army Tactics Center, Dresden, Germany, 4-7 November 2003

#### **Client Presentations**

Brence, John R. Ph.D., Kwinn, Michael J. Jr. Ph.D., *Recruiter Allocation Model: Final Research Brief*, Briefing to LTC Stephen McCarty, LTC(R) Rick Ayer, MAJ Jon Shupenus, MAJ Vincent O'Rourke and Ms. Rae Disney (USAAC & USAREC). Fort Knox, KY. 13 July 2004.

Brence, John R. Ph.D., Kwinn, Michael J. Jr. Ph.D., *Recruiter Allocation Model: An In Progress Review*, Briefing to LTC Stephen McCarty and MAJ Vincent O'Rourke (USAAC & USAREC). West Point, NY, 4 May 2004

**Number of Refereed Journal Publications you reviewed: 4**

**Number of Refereed Conference Proceedings Publications you reviewed: 2**

**BURK, ROGER C., PH.D.**

**Refereed Journal Publication**

Parnell, G. S.,\* Roger C. Burk,\* A. Schulman, D. Westphal, L. Kwan, J. L. Blackhurst, P. M. Verret, H. A. Karasopoulos. "Air Force Research Laboratory Space Technology Value Model: Creating Capabilities for Future Customers." *Military Operations Research*, Vol. 9, No. 1, pp. 5-17, 2004.

**Non-Refereed Publications**

Burk, Roger,\* Tim Trainor,\* Dave Wallace, Fred Kagan. "Faculty Professional Development after the First Year." United States Military Academy Faculty Council, May 2004.

DeLong, Suzanne O.,\* Eric S. Tollefson,\* Roger C. Burk.\* *Modeling of HEL Weapons in Army Combat Simulations*. Technical Report DSE-TR-03-02, United States Military Academy, September 2003.

**Conference Presentations**

Eissler, Burt, Heather Ritchey, William Yun, Roger Burk. "System Analysis of a Micro Air Vehicle for the Army," Military Operations Research Society Symposium, Monterey, CA, 23 June 2004.

Burk, Roger C. "Variations on the Problem of Selecting a Portfolio of R&D Projects," CORS/INFORMS Joint International Meeting, Banff, AB, 17 May 2004.

Burk, Roger,\* Suzanne O. DeLong.\* "Data Collection for the ABET Self-Study and Beyond," Best Assessment Processes VI Symposium, Terre Haute, IN 2 Mar 2004.

Burk, Roger C.,\* Gregory Parnell,\* Brian Stokes.\* "Selecting a Portfolio of Research and Development Projects," INFORMS Annual Meeting, Atlanta, GA, 19 Oct 2003.

**Client Presentation**

Eissler, Burt, Heather Ritchey, William Yun, Roger Burk. "Analysis of a Micro Air Vehicle for the Army," presented to Joseph L. Bergantz (Program Executive Officer, Aviation), 4 May 2004.

**Number of Refereed Journal Publications Reviewed: 2**

**DRISCOLL, PATRICK J., PH.D.**

**Refereed Journal Publications**

Driscoll, Patrick J. 2003. "Judges Commentary: The outstanding wind and waterspray problem," *Undergraduate Mathematics Applications Journal*, Special Edition on Mathematical Modeling, 23(3), 267 – 271.

Driscoll, Patrick J. 2004. "Building a Modeling Community: MATHmodels.org," *Undergraduate Mathematics Applications Journal*, 25(2), Invited Guest Editorial, 93 – 96.

#### **Conference Presentations**

Driscoll, P.J.\*, E. Pohl\*, M. Tortorella. "NCW Conceptual Framework and Uncertainty," Joint International conference of the Canadian Operations Research Society (CORS) and the Institute for Operations Research and the Management Sciences (INFORMS), Banff, Canada, May, 2003.

Driscoll, P.J.\*, and S. Henderson\*, "Identifying Unknown Force Operational States," Joint International conference of the Canadian Operations Research Society (CORS) and the Institute for Operations Research and the Management Sciences (INFORMS), Banff, Canada, May, 2003.

#### **Professional Society Officer Positions**

Chairperson, INFORMS COMAP Committee, a subcommittee of the INFORMS Educational Committee.

**Number of Refereed Journal Publications you reviewed: 4**

**Number of Refereed Conference Proceedings Publications you reviewed: 2**

#### **FOOTE, BOBBIE LEON, PH.D.**

##### **Refereed Journal Publications**

Ingalls, Ricki G and Foote, Bobbie L., "Reducing the Bullwhip Effect in Supply Chains With Control Based Forecasting" Accepted by *International Journal of Simulation and Process Modeling*, March 2004.

Foote, Bobbie Leon and Glen, Andrew G, "Determining the Contribution of New Components Added in Parallel to a Parallel System" Published by *International Journal of Pure and Applied Mathematics*, v6, #1, pp51-61, 2003.

##### **Refereed Conference Proceedings Publications**

Tollefson\*, Eric, Foote\*, Bobbie L, and others, "Simulation Modeling Requirements for Determining Soldier Tactical Mission System Effectiveness" *WinterSim Conference*, Washington, DC, December 2004

Tollefson\*, Eric, Foote\*, Bobbie L, and others 2004 IERC, Houston , TX, 5/18, "A Needs Based Analysis of Analytical High-Resolution Infantry Simulation" *IERC Conference*, Houston TX 5/18/2004.

Kaczynski, William, Foote\*, Bobbie L and Pohl\*, Ed, "A Utility Based Optimal Metric Coordinating Mission Capability and Supply Level", *IERC*, Houston, TX, 5/16, 2004.

Foote\*, Bobbie L, Kaczynski, William, Henderson\*, Steve and Pohl\*, Ed, "A New Metric for Reporting Readiness and an Inventory Replenishment Model", *MORS*, June 2004.



**Non Refereed Publications**

Pohl\*, Ed, Foote\*, Bobbie L. and others, "Establishing a Decision Support Framework for Analysis of Embedded Training", Technical Report DSE-TR-0304, DTIC #: ADB292656, Oct 2003.

Foote, Bobbie L, Hall, Mary L, and others," Air Warrior Comanche", Technical report DSE-TR-0305, completed July-August 2003.

Foote, Bobbie L, and Glen, Andrew G, "Analysis of Reliability When Data Is Masked", Technical Report, DSE-TR-0330, Completed Summer 2003

**Books or Book Chapters**

Chapter on Scheduling, Edited by A Badiru, "Handbook of Industrial and Systems Engineering", 2005. Refereed.

**GAY, RALPH H. III, PH.D., LIEUTENANT COLONEL****Awards**

Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, (advisors: Gay, R.\*, Schott, R.\*, Downes, R.\*), "Bradley Medium Caliber Cannon Study." USMA Systems Engineering Capstone Conference, Best Project-Modeling and Simulations, May 2004, West Point, NY.

Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, (advisors: Gay, R.\*, Schott, R.\*, Downes, R.\*), "Bradley Medium Caliber Cannon Study." USMA Systems Engineering Capstone Conference, Hollis Award, May 2004, West Point, NY.

**Refereed Journal Publication**

Gay, R., Davis, B., Phillips, D. Sui, D, *Modeling Paradigms for the Environmental Impacts of the Emerging Digital Economy*, accepted to the Journal of Organizational Computing and Electronic Commerce.

**Refereed Conference Proceedings Publications**

Schott, R.\*, Gay, R.\*, Downes, P.\*, Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, "Simulating Lethality Capabilities for the Army's Next Generation Cannon." Institute of Industrial Engineers Simulation Solutions Conference, March 2004, Orlando, Florida.

Gay, R.\*, Downes, P.\*, Schott, R.\*, Paine, J.\*, Whitten, N.\*, "The U.S. Army's Next Medium Caliber Cannon for the Mechanized Infantry." Institute of Industrial Engineers Annual Conference, May 2004, Houston, Texas.

Schott, R.\*, Downes, P.\*, Gay, R.\*, Rippert, T.\*, Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, Klimack, W.\*, "Medium Caliber Cannon Lethality Study for Future & Current Infantry Fighting Vehicles" Military Operations Research Symposium, Monterey, California, June 2004.

**Conference Presentations**

Gay, R.\*, Schott, R.\*, Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*  
"New Generation Medium Caliber Weapons for Infantry Fighting

*Vehicles.*" INFORMS Annual Conference, October 2003, Atlanta, Georgia.

Schott, R.\*, Gay, R.\*, Downes, P.\*, Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, "*Simulating Lethality Capabilities for the Army's Next Generation Cannon.*" Institute of Industrial Engineers Simulation Solutions Conference, March 2004, Orlando, Florida.

Gay, R.\*, Downes, P.\*, Schott, R.\*, Paine, J.\*, Whitten, N.\*, "*The U.S. Army's Next Medium Caliber Cannon for the Mechanized Infantry.*" Institute of Industrial Engineers Annual Conference, May 2004, Houston, Texas.

Schott, R.\*, Downes, P.\*, Gay, R.\*, Rippert, T.\*, Rybacki, M.\*, Goddard, M.\*, Whitten, N.\*, Paine, J.\*, Klimack, W.\*, "*Medium Caliber Cannon Lethality Study for Future & Current Infantry Fighting Vehicles*" Military Operations Research Symposium, Monterey, California, June 2004.

#### **GORAK, MARK, M.S., Major**

##### **Non-Refereed Publications**

Gorak, Mark, Costa, Gabriel and Melendez, Barbara. "*Visualization of 2D to 3D Transformations – Technology*", submitted for review in Exploration thru The College Mathematics Journal, March 2004.

Gorak\*, Mark, Kwinn\*, Michael J., Jr., Pohl\*, Edward A., and Lee, Jong. "*Lead-the-Fleet: Transitioning Army Aviation Maintenance Program from a flight time based system to an operational usage based system*", Department of Systems Engineering, Technical Report, June 2004.

##### **Refereed Conference Proceedings Publications**

Gorak\*, Mark, Kwinn\*, Michael J., Jr., Pohl\*, Edward, and Lee, Jong. *Lead-the-Fleet: Transitioning Army Aviation maintenance program from a flight time based system to an operational usage based system*, 13th Annual Industrial Engineering Conference: May 2004.

##### **Non-Refereed Conference Presentations**

Gorak\*, Mark, Kwinn\*, Michael J., Jr., and Lee, Jong. *Lead-the-Fleet: Transitioning Army Aviation maintenance program from a flight time based system to an operational usage based system*. The International Test & Evaluation Association (ITEA) 2004 conference, September 2004.

Gorak\*, Mark, Kwinn\*, Michael J., Jr., Pohl\*, Edward A., and Lee, Jong. *Lead-the-Fleet: Transitioning Army Aviation maintenance program from a flight time based system to an operational usage based system*. Military Operations Research Society Symposium 72nd MORSS. June 2004.

Gorak\*, Mark, Kwinn\*, Michael J., Jr., Pohl\*, Edward A., Ragsdale, Daniel J., Brence\*, John R., Morel, Thomas, Goldman, Stephen, Tollefson\*, Eric, Deckro, Richard F., and Carver, Curtis A. *Operation Enduring Freedom Assessment System Development*, US/Korea OR Symposium, April 2004

Gorak, Mark, Costa, Gabriel, and Melendez, Barbara. *Visualization of 2D to 3D Transformations – Exploration Thru Technology*, The Effective Use of

Computer Algebra Systems in the Teaching of Mathematics, Joint Mathematics Conference of the American Mathematical Society/Mathematical Association of America (AMS/MAA) Conference, January 2004.

Gorak, Mark and Myers, Joseph. *Visualizations in Fractional Calculus*, Computational Mathematics in Linear Algebra and Differential Equations, Joint Mathematics Conference of the American Mathematical Society/Mathematical Association of America (AMS/MAA) Conference, January 2004.

#### **Client Presentations**

Gorak\*, Mark, Kwinn\*, Michael J., Jr., Pohl\*, Edward. "*Lead-the-Fleet task update brief*", presented to Mr. Jong Lee, A-PM LTF, and Mr. Erich Erker, LTF Maintenance Manager. February 2004.

Gorak\*, Mark, Kwinn\*, Michael J. Jr., and Lee, Jong. "*Lead-the-Fleet reorganization meeting*", presented to Mike McFalls, PM LTF. March 2004

Gorak\*, Mark, Kwinn\*, Michael J., Jr., and Lee, Jong. "*Lead-the-Fleet out brief and ORCEN recommendations*", May 2004

#### **HARRIS, JOHN K., M.S., Major**

##### **Non-Refereed Publications**

Harris\*, John K. and Gregory S. Parnell\*, PhD. BRAC 2005 Implementation Decision Support Tools. Technical Report ORCEN. July 2004.

##### **Refereed Conference Proceedings Publications**

Harris\*, John K. and Gregory S. Parnell\*, PhD, "Army BRAC 2005 Implementation", Accepted by the Proceedings of the American Society for Engineering Management Conference 2004.

##### **Conference Presentations**

Harris, John K. and Donald E. Brown, PhD, "Identifying Threat Force Ground Systems in the Battlespace," Institute for Operations Research and the Management Sciences, Atlanta, GA, Oct. 2003.

##### **Client Presentations**

Harris, J.\*, and Parnell, G.\* "BRAC 2005 Implementation Complexity Model." Presentation to Dr. Craig College, Deputy Assistant Secretary of the Army (Infrastructure Analyses), March and May 2004.

#### **HOYLE, HEIDI, M.S., Captain**

##### **Refereed Conference Proceeding Publications**

Brown, Donald, Jason Dalton, Heidi J. Hoyle. *Spatial Forecast Methods for Terrorist Events in Urban Environments*. Conference proceedings for 2<sup>nd</sup> Symposium on Intelligence and Security Informatics. Tucson, Arizona. June, 2004.

**KLIMACK, WILLIAM K., PH.D., Colonel**

**Awards**

Decision Analysis Society 2003 Practice Award Recipient, Institute for Operations Research and Management Science.

Best Paper Nominee, 2003 Interservice/Industry Training Simulation and Education Conference, Orlando, Florida, December 2003.

**Refereed Publications**

Farrell, Christopher\*, William K. Klimack, and Carl Jacquet. "Employing Interactive Multimedia Instruction in Military Science Education at the U.S. Military Academy," was nominated for Best Paper for the 2003 Interservice/Industry Training Simulation and Education Conference, Orlando, Florida, December 2003.

**Conference Presentations**

Klimack, William K., and Jack M. Kloeber, Jr. "Basic Combat Training Program of Instruction Review," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Klimack, William K. "Military Relative Risk Aversion," 70<sup>th</sup> MORSS, MCB Quantico, Virginia, June 2003.

Klimack, William K. "Hybrid Value-Utility Model," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Klimack, William K. "The ORCEN at USMA," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Klimack, William K. "Taking a bite of the apple: Examining Jaguar OS in a WINTEL world," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Klimack, William K. "FCS Unit Set Fielding," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Farrell, Chris\*, and William K Klimack. "Interactive Multimedia Instruction for Military Education," INFORMS Annual Conference, Atlanta, Georgia, November 2003.

Farrell, Chris\*, and William K Klimack. "Interactive Multimedia Instruction for Military Education," I/ITSEC 25<sup>th</sup> Annual Conference, Orlando, Florida, December 2003.

**Client Presentations**

Klimack, William K. "FCS Unit Set Fielding," CG TRADOC, June 2003.

**Professional Society Officer Positions**

Member of the Executive Board, Military Applications Society, Institute for Operations Research and Management Science.

Session Chair, INFORMS Annual Conference, Atlanta, GA, October 2003

Advisor for Working Group 28, Decision Analysis, Military Operations Research Society

Member of Board of Directors, National Speleological Society.

Member of the Science Advisory Board, Explorers Club.

**Number of Refereed Journal Publications Reviewed: 1.**

**KWINN, MICHAEL J., JR. PH.D., Lieutenant Colonel**

**Refereed Journal Publications**

Brockett, P. L. Cooper, W. W., Kumbhakar, S., Kwinn, M. J.\*, and McCarthy, D., *Alternative Statistical Regression Studies of the Effects of Joint and Service Specific Advertising on Military Recruitment*, accepted for publication in The Journal of the Operational Research Society, March 2004.

**Refereed Conference Proceedings Publications**

Gorak, Mark\*, Kwinn, Michael J. Jr.\*, Pohl, Edward, and Lee, Jong, "Lead-the-Fleet: Transitioning Army Aviation maintenance program from a flight time based system to an operational usage based system" in the Proceedings of the IIE Annual Conference, Houston, TX, May 2004.

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, Boylan, G. L.\*, Foote, B. L.\*, and West, P. D.\*, 2004, "A Needs-based Analysis of Analytical, High-Resolution Infantry Simulations," in the Proceedings of the IIE Annual Conference, Houston, TX, May 2004.

Brence, J.\*, Kwinn, M. J.\*, Thomas, D. A., "Modeling for US Army Recruiter Allocation", in the Proceedings of the IIE Annual Conference, Houston, TX, May 2004.

Kwinn, M. J., Jr.\*, Ragsdale, D. J., Brence, J.\*, Morel, T., Pohl, E. A., Goldman, S., Tollefson, E. S.\*, Gorak, M.\*, Deckro, R. F., Carver, C. A., 2004, "Operation Enduring Freedom Assessment System Development," in the Proceedings of the Defense Analysis Seminar XII, Seoul, Korea.

**Non-Refereed Publications**

Kwinn, M. J., Pohl, E. A., Deckro, R., F., "Combat Consultants", *Phalanx*, pp. 10-11, 30, Vol 36, No. 4, December 2003.

Downes, P.\*, Kwinn, M. J.\*, Brown, D., "Incorporating Battle Focused Training and Operations Research", *Phalanx*, pp. 6-9, Vol 37, No. 2, June 2004.

Brence, John R.\*, Kwinn, Michael J. Jr.\*, Wolter, Jason A.\*, A White Paper Summary: Recruiter Management Workshop, Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 30 March 2004.

Wolter, Jason A.\*, Kwinn, Michael J. Jr.\*, Brence, John R.\*, A White Paper Summary: An Overview of Research Conducted on the DoD's Delayed Entry Program (DEP), Operations Research Center of Excellence,

Department of Systems Engineering, United States Military Academy,  
West Point, NY, 2 April 2004.

#### **Conference Presentations**

Gorak, Mark, Kwinn, Michael J. Jr.\*, Pohl, Edward., and Lee, Jong., "Lead-the-Fleet: Transitioning Army Aviation maintenance program from a flight time based system to an operational usage based system" Presentation to the Military Operations Research Society Symposium 72nd MORSS, June 2004.

Kwinn, M. J., Pohl, E., Deckro, R., and Ragsdale, D., "Using Quantitative Means to Measure Success and Identify Directions in Effects Based Operations", Presentation for the Military Operations Research Society Symposium, June 2004.

Kwinn, M. J.\*, Brence, J.\*, Morel, T., Pohl, E., and Deckro, R., "Assessment in Afghanistan using Value Focused Thinking", Presentation for the Military Operations Research Society Symposium, June 2004.

Wolter, Jason A.\*, Kwinn, Michael J. Jr.\*, Brence, John R.\*, An Analysis of an Optimization Management System for the Delayed Entry Program (DEP). Presentation for the Military Operations Research Society Symposium, June 2004.

Brence, John R.\*, Kwinn, Michael J. Jr.\*, Thomas, D. A., "Quantitative and Qualitative Means for Improving US Army Recruiting", Presentation for the Military Operations Research Society Symposium, June 2004.

Kwinn, Michael J.\*, Edward A. Pohl, Richard, Deckro, Gus Kostas, John Brence, Mark Gorak, Eric Tollefson, "Afghanistan National Development Assessment System (ANDAS)", US/GE Operations Research Symposium, 5 Nov 2003.

#### **Client Presentations:**

Brence, John R.\*, Kwinn, Michael J. Jr.\*, Recruiter Allocation Model: Final Research Brief, Briefing to LTC Stephen McCarty, LTC(R) Rick Ayer, MAJ Jon Shupenus, MAJ Vincent O'Rourke and Ms. Rae Disney (USAAC & USAREC). Fort Knox, KY. 13 July 2004.

Gorak, Mark\*, Kwinn, Michael J. Jr.\*, and Lee, Jong., Lead-the-Fleet out brief and ORCEN recommendations, Presented to Mr. Mike McFalls, PM-LTF and Mr. Bill Brady, Deputy PM-LTF, May 2004.

Kwinn, M. J.\*, Pohl, E. A., Deckro, R. F., "CJTF 180 Assessment Analysis", presented to MG(P) Barno, Commander, Combined Forces Command – Afghanistan, Oct 2003.

Wolter, J.\*, Kwinn, M. J.\*, "Optimal In and For Analysis", presented to LTC(R) Rick Ayer, US Army Accessions Command, June 2004.

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, Boylan, G. L.\*, Foote, B. L.\*, and West, P. D.\*, "A Needs-based Analysis of Analytical, High-Resolution Infantry

Simulations,” presented to Mr. Charles Rash, Mr. Ross Guckert, and Mr. Charles Tamez, March 2004.

**Professional Society Officer Positions**

Member, Board of Directors, Military Operations Research Society

**Awards**

Barchi Prize nomination for WG20, Military Operations Research Society, for Brence, John R.\*, Kwinn, Michael J. Jr.\*, Thomas, D. A., “Quantitative and Qualitative Means for Improving US Army Recruiting”, Presentation for the Military Operations Research Society Symposium, June 2004.

**Number of Refereed Journal Publications reviewed: 3.**

**PARNELL, GREGORY S., PH.D.**

**Awards**

United States Military Academy, Phi Kappa Phi Scholastic Achievement Award, 2004

**Refereed Journal Publications**

Parnell\*, G., Burk\*, R., Schulman, A., Westphal, D., Kwan, L., Blackhurst, J., Verret, P, and Karasopoulos, H., “Air Force Research Laboratory Space Technology Value Model: Creating Capabilities for Future Customers,” *Military Operations Research*, 2004, Vol 9, No 1, pp. 5-17

**Refereed Conference Proceedings Publications**

Kwinn\*, M., Pohl\*, E., and Parnell\*, G., “Rapid Framework Development and Analysis using Technology,” 2003 IEEE International Engineering Management Conference (IEMC -2003): Managing Technologically Driven Organizations: "The Human Side of Innovation and Change," Albany, New York, 2-4 November 2003

Parnell, G., Blair, J., Carver, C., Ray, C., & Matthews, M., “Genesis of the New Information Systems Engineering Program at the United States Military Academy at West Point,” Proceedings of the 2003 International Conference on Information Systems and Engineering (ISE 2003), Montreal, Quebec, Canada, July 20 - 25, 2003.

**Non-Refereed Publications**

Army BRAC 2005 Analysis Methodology, The Army Basing Study, June 2004.

**Conference Presentations**

Parnell, G. S., Tarantino, and W., Bott, J., “Army Installation Military Value Assessment,” Institute for Operations Research and Management Science, October 21, 2003, Atlanta, GA.

Parnell, G. S., and Deckro, R., “Value of Intelligence,” Institute for Operations Research and Management Science, October 21, 2003, Atlanta, GA.

Parnell, G. S., "Alternative Techniques for Analyzing IT-based Systems"  
Canadian Operations Research Society Annual Meeting, Banff, Canada,  
May 16-19, 2004

**Professional Society Officer Positions**

Member, Technology Panel of the National Security Agency Advisory Board,  
2003-present.

President-Elect, Decision Analysis Society, INFORMS, 2002-2004.

**Books or Book Chapters**

Parnell, G. S., *Value-Focused Thinking Using Multiple Objective Decision  
Analysis, Methods for Conducting Military Operational Analysis: Best  
Practices in Use Throughout the Department of Defense*, Military  
Operations Research Society, Final Draft, 29 Jun 2004.

**Number of Refereed Journal Publications Reviewed: 8**

**POWELL, ROBERT A., PH.D., Lieutenant Colonel**

**Refereed Journal Publications**

Hampton, R. David, D. Nash, D. Barlow, R. Powell, and S. Young. "An  
Autonomous Tracked Vehicle with Omnidirectional Sensing," *Journal of  
Robotic Systems Special Issue*, 2004.

**Refereed Conference Proceedings Publications**

Powell, R.A. and Curtis Tait. "Developing Engineers in the 21st Century – An  
Integrative Experience," *Integrating Practice into Engineering Education  
Conference*, University of Michigan, Dearborn, Dearborn, Michigan, 3-5  
October 2004. (Paper Accepted)

Powell, R.A. "Building an Engineer through a Work-Based Education Program,"  
Proceedings of the American Society for Engineering Education 2004  
*Annual Conference and Exposition*, Salt Lake City, Utah, 20-23 June  
2004.

Powell, R.A. and Michael J. Kwinn Jr. "Enhancing Engineering Education  
through Global Co-ops," Urban Engineering Schools-Serving a Global  
Community: Proceedings of the *Fall 2003 American Society for  
Engineering Education Middle Atlantic Section Conference*, Baltimore,  
Maryland, 24-25 October 2003.

**Conference Presentations**

Powell, R.A. (Author) and Curtis D. Tait (Author/Presenter). "Developing  
Engineers in the 21<sup>st</sup> Century – An Integrative Experience," *Integrating  
Practice into Engineering Education Conference*, University of Michigan  
Dearborn, Dearborn, Michigan, 3-5 October 2004. (Paper Accepted)

Powell, R.A. "Building an Engineer through a Work-Based Education Program,"  
Proceedings of the *American Society for Engineering Education 2004  
Annual Conference and Exposition*, Salt Lake City, Utah, 20-23 June 2004.



Powell, R.A. (Author/Presenter) and Michael J. Kwinn Jr. (Author) "Enhancing Engineering Education through Global Co-ops," Urban Engineering Schools-Serving a Global Community: Proceedings of the *Fall 2003 American Society for Engineering Education Middle Atlantic Section Conference*, Baltimore, Maryland, 24-25 October 2003.

**Number of Refereed Conference Proceedings Publications Reviews: 2.**

**TOLLEFSON, ERIC S., M.S., Captain**

**Non-Refereed Publications**

Tollefson, E. S.\*, Boylan, G. L.\*, Kwinn, M. J., Jr.\*, Foote, B. L.\*, and West, P. D.\*, *Simulation Roadmap for Program Executive Office (PEO) Soldier*, Operations Research Center Technical Report [DSE-R-0421], to be published in August, 2004.

**Refereed Conference Proceedings Publications**

Kwinn, M. J., Jr.\*, Ragsdale, D. J., Brence, J.\*, Morel, T., Pohl, E. A.\*, Goldman, S., Tollefson, E. S.\*, Gorak, M.\*, Deckro, R. F., Carver, C. A., 2004, "Operation Enduring Freedom Assessment System Development," in the *Proceedings of the Defense Analysis Seminar XII*, Seoul, Korea.

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, Boylan, G. L.\*, Foote, B. L.\*, and West, P. D.\*, 2004, "A Needs-based Analysis of Analytical, High-Resolution Infantry Simulations," in the *Proceedings of the 2004 IIE Annual Conference*, Houston, TX.

**Client Presentations**

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, West, P. D.\*, and Jacquet, C., "USMA Presentation on PEO Soldier Projects," Presentation to Mr. Charles R. Rash, Deputy PEO Soldier, Initial Project Briefing – 14 November 2003.

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, Foote, B. L.\*, and West, P. D.\*, "Simulation Roadmap for PEO Soldier Programs; IPR #1," Presentation to Mr. Charles R. Rash, Deputy PEO Soldier, IPR #1 – 19 December 2003.

Tollefson, E. S.\*, Kwinn, M. J., Jr.\*, Boylan, G. L.\*, Foote, B. L.\*, and West, P. D.\*, "Simulation Roadmap for PEO Soldier M&S: Project Update," Presentation to Mr. Ross Guckert, Lead, Systems Integration, PEO Soldier, IPR #2 – 22 March 2004.

Tollefson, E. S.\*, Boylan, G. L.\*, Kwinn, M. J., Jr.\*, Foote, B. L.\*, and West, P. D.\*, "Final Decision Briefing," Mr. Charles R. Rash, Deputy PEO Soldier, FDB – 14 May 2004.

**Professional Society Officer Positions**

Treasurer, Phi Kappa Phi Honor Society, USMA Chapter #204

**Number of Refereed Conference Proceedings Publications you reviewed: 2**

**TRAINOR, TIMOTHY, PH.D., Lieutenant Colonel**

**Refereed Conference Proceedings Publications**

Welch, Ronald W., Trainor, T., Crowe, R., Zuzulock, A. *Homeland Security Training Facility Capstone*. Proceedings of the Fall 2003 American Society for Engineering Education Middle Atlantic Section Conference. Fall, 2003..

**Non-Refereed Publications**

Trainor, Timothy E., *Force Deployment Scheduler*. FORSCOM Analysis Modeling and Simulation Newsletter, Edition 4, February 2004, p. 5.

**Books and Chapters**

Hodgson, T.J., Barbra Melendez, Kristin A. Thoney, Timothy E. Trainor. *The Deployment Scheduling Analysis Tool (DSAT)*. Appears in *Defense Transportation: Algorithms, Models and Applications for the 21<sup>st</sup> Century*, pp. 905-924, Elsevier, 2004. (Reprinted from the Journal of Mathematical and Computer Modeling, Volume 39, No. 6-8, 2004).

**Conference Presentation**

Trainor, T. and Welch, R. *Creating a Center for Homeland Defense Research and Training*. Presentation at the INFORMS Annual Meeting, October 2003.

Hodgson, T.J., Melendez, B., Thoney, K.A., Trainor, T. and Williams, M. *The Deployment Scheduling Analysis Tool (DSAT)*. Presentation at the INFORMS Annual Meeting, October 2003.

Magras\*, P. and Trainor\*, T. *The Installation Vulnerability Assessment Tool (IVAT)*. Presentation at the INFORMS Annual Meeting, October 2003.

Welch, R. and Trainor, T. *Homeland Security Training Facility Capstone*. Presentation at the American Society of Engineering Education (ASEE) Mid Atlantic Section Fall 2003 Conference, October 2003.

Trainor, T. and Melendez, B. *The Deployment Scheduling Analysis Tool (DSAT)*. Presentation to the Director of the Center for Army Analysis (CAA) of continuing work on DSAT for the Military Traffic Management Command (MTMC), August 2003.

**Number of Refereed Conference Proceedings Publications you reviewed: 1**

**WOLTER, JASON, M.S., Captain**

**Non-Refereed Publications**

Brence\*, John R., Ph.D., Kwinn\*, Michael J. Jr., Ph.D., Wolter\*, Jason A., A White Paper Summary: Recruiter Management Workshop, Operations Research Center of Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 30 March 2004.

Wolter\*, Jason A. , Kwinn\*, Michael J. Jr., Ph.D., Brence\*, John R., Ph.D, A White Paper Summary: An Overview of Research Conducted on the DoD's Delayed Entry Program (DEP), Operations Research Center of

Excellence, Department of Systems Engineering, United States Military Academy, West Point, NY, 2 April 2004..

**Conference Presentations**

Wolter\*, Jason A. , Kwinn\*, Michael J. Jr., Ph.D., Brence\*, John R., Ph.D, An Analysis of an Optimization Management System for the Delayed Entry Program (DEP). 72nd MORS Symposium, 22-24 June 2004, Naval Postgraduate School.

**Professional Society Officer Positions**

President, West Point Chapter, American Society of Engineering Managers

## PART VII - Distribution List

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Commander US Army Nuclear & Chemical Agency	7500 Backlick Road – Bldg #2073 Springfield, VA 22150	1
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Commander US Army Recruiting Command	ATTN: RCPAE Ft. Knox, KY 40121	1
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Director US Army National Simulation Center	ATTN: ATZL-NSC 410 Kearney Avenue – Building 45 Ft. Leavenworth, KS 66027-1306	1
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Cdr, USASMDC	ATTN: SMDC-BL P.O. Box 1500 Huntsville, AL 35807-3801	1
Cdr, USARSPACE	ATTN: SMDC-BL-W 1670 North Newport Road Colorado Springs, CO 80916-2749	1
Comdt, USAADASCH	ATTN: ATSA-CDB 5800 Carter Road Ft. Bliss, TX 79916-3802	1
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Battle Command Ft. Leavenworth Cdr, USACAC	ATTN: ATXH-BLT Ft. Leavenworth, KS 66027-5300	1
Depth & Simultaneous Attack Comdt, USAFAS	ATTN: ATSF-CBL Ft. Sill, OK 73503-5600	1
Battle Command Ft. Gordon Cdr, USASC&FG	ATTN: ATZH-BLT Ft. Gordon, GA 30905-5294	1
Mounted Battle Space Cdr, USAARMC	ATTN: ATZK-MW Ft. Knox, KY 40121-5000	1
Battle Command Ft. Huachuca Cdr, USAIC&FH	ATTN: ATZS-CDT Ft. Huachuca, AZ 85613-6000	1
Dismounted Battle Space Comdt, USAIS	ATTN: ATSH-IWC Ft. Benning, GA 31905-5007	1
Combat Service Support Cdr, USACASCOM	ATTN: ATCL-C Ft. Lee, VA 23801-6000	1
Early Entry Lethality and Survivability Cdr, USATRADO	ATTN: ATCD-L Ft. Monroe, VA 23651-5000	1

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PM-Logistics Information Systems (LIS)	800 Lee Avenue Fort Lee, VA 23801-1718	1
PM Lead The Fleet (LTF) Army Test & Evaluation	AMRDEC, US Army RDECOM AMSAM-RD, Bldg. 8716 Redstone Arsenal, AL 35898	1
Commander US Joint Forces Command	1562 Mitscher Ave. Suite 200 Norfolk, VA 23551	1
Deputy Chief of Staff for Personnel Army G-1	300 Army Pentagon Washington, DC 20310-0300	1
Deputy Chief of Staff Training & Leader Development Directorate Army G-3	300 Army Pentagon Washington, DC 20310-0300	1
Deputy Chief of Staff for Logistics Army G-4	300 Army Pentagon Washington, DC 20310-0300	1
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Commander US Army Accessions Command (USAAC)	90 Ingalls Road – Bldg. 100 Ft. Monroe, VA 23651	1
Director, Defense Advanced Research Project Agency (DARPA)	3701 North Fairfax Drive Arlington, VA 22203-1714	2
Program Executive Officer (PEO) Soldier	5901 Putnam Road, Bldg 328 Fort Belvoir, VA 22060-5422	1
Director TACOM-ARDEC	AMSTA-AR-TD Bldg 1, 3rd Floor Picatinny Arsenal, NJ 07806-5000	1
Director Operational Test Command (OTC)	Aviation Test Directorate Ft Hood, TX 76544	1
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